RADIOLOGY

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Vol. 54 MAY 1950 No. 5

Diagnosis of Renal Tumors in the Adult[1]

DAVID M. DAVIS, M.D.

Philadelphia, Penna.

THE DIAGNOSIS of renal tumors has in the past and must in the future depend largely upon the skillful cooperation of the roentgenologist and the urologist. There are very few benign tumors of the kidney, and no diagnostic method known at present enables us in any way to distinguish between the benign and the malignant. We must therefore regard all renal neoplasms as malignant, at least until proved otherwise by pathologic examination and clinical course. This being the case, the physician's problem, as in all forms of malignant growth, is that of early diagnosis.

Unfortunately for us, and for the patients, many renal tumors exist for long periods without causing any symptoms. During this interval, which might be called the latent period, the growth may extend to such a degree that operative removal becomes impossible, or distant metastases may occur and make the disease incurable.

During a similar symptomless latent period certain malignant tumors can be detected by careful routine examinations. In this category lie, first, tumors of the skin, including those of the lip, penis, and vulva; second, tumors lying just within the natural orifices, including those of the eyeball, nose, throat, tongue, vagina, cervix, uterus, rectum and prostate; third, tumors situated close enough under the surface to be palpated, including those of the subcutaneous tissues, the breast, and certain tumors of the bones, cartilages and muscles; and fourth, tumors visible in routine roentgenograms, particularly those of the lungs and bronchi. Other internal tumors, however, such as those of the esophagus, intestine, liver, pancreas, bladder, brain, and spinal cord cannot be detected on routine examination, and must await the onset of symptoms before the more elaborate methods of diagnosis are applied. Renal tumors are in this category.

Certain biochemical methods have been investigated with the idea that they might indicate the presence of a malignant neoplasm somewhere in the body. These methods are as yet not sufficiently reliable but it is to be hoped that they will eventually be developed to a point where they may be useful. If so, they will be very helpful. The only procedure so far recommended which might disclose a renal tumor in the presymptomatic stage is the cytologic method of Papanicolaou, in which malignant cells are demonstrated in the urinary sediment. This method, which at first seemed to hold great promise, has been found to be very difficult of general application. A lengthy training is necessary for even a skillful pathologist to learn to iden-

[1] From the Department of Urology, Jefferson Medical College, Philadelphia, Penna. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

tify the malignant cells with certainty, and the time necessary for each examination makes the procedure impracticable for the screening of large numbers of patients.

We find ourselves, therefore, still in the situation where diagnosis of renal tumors in the presymptomatic stage is entirely impossible except on the basis of purely accidental findings. One might mention cases in which pelvic deformities are seen in intravenous urograms taken for other reasons, cases in which metastases or implants are found in other organs, particularly the lungs and bladder, cases in which the tumor has grown to such great size that it is palpable, and cases in which an early tumor is found in a kidney operated upon for another reason. I personally can recall but one case coming in this last category. A middle-aged woman was found to have a moderate-sized left hydronephrosis, infected and containing a stone 2.0 cm. in diameter. I operated upon her with the idea of removing the stone and relieving the ureteropelvic obstruction. At operation, a tumor 2.0 cm. in diameter was found on the surface of the lower half of the kidney. Preoperative roentgenograms had given no inkling of its presence, and careful study of the kidney after its removal showed that the tumor, a typical clear-cell carcinoma or hypernephroma, was entirely confined to the parenchyma, and had not as yet caused the slightest filling defect or other deformity of the pelvis. This patients remains well about five years after nephrectomy.

In view of the great difficulty of presymptomatic diagnosis of renal tumors, we can, at the present time, only determine, all of us, roentgenologists and urologists alike, to be ever on the alert for the slightest clue casting suspicion on the kidney as the seat of a neoplasm. Intravenous urography, as part of a routine examination, or done for other reasons than suspicion of a renal tumor, has disclosed a number of presymptomatic neoplasms, and is one of our most useful aids. In every case of papilloma of the bladder or urethra, we should investigate the upper urinary tract, never forgetting that the ureter as well as the renal pelvis may be the site of the primary tumor.

The observations which usually cause a renal tumor to be suspected, and therefore bring about a thorough study of the urinary tract, may be listed as follows: hematuria; a mass in the kidney region; pain in the kidney region; papillomata in the bladder or urethra; tumors elsewhere in the body, particularly in the lung or supraclavicular lymph nodes, which may be metastases from renal tumors; suspicious findings on routine intravenous urography; the finding of malignant cells in the urinary sediment.

Hematuria, whether it is painless or associated with pain and other urinary symptoms, and whether or not another possibly adequate cause is present, should always direct suspicion to the kidney. In a recent case, the patient complained only of frequent and painful voiding. There had never been any gross hematuria. Examination showed a contracted vesical orifice, a heavy bacillary infection of the bladder urine, numerous leukocytes, and a few red blood cells, about 5 to 8 per high-power field. This number of red cells could easily have been caused by the infection. Later investigation, however, revealed a tumor of the left kidney.

A *palpable mass* can be caused by many things besides a renal tumor. It must be remembered, however, that a tumor can coexist with any other lesion of the kidney or in the region of the kidney.

Pain is an infrequent symptom of renal tumor, but its presence in no way rules out neoplasm.

By far the greatest number of *metastases* from renal tumors are found in the lungs, but metastasis may occur to any organ or tissue of the body, with or without coexistent lesions in the lungs. Solitary metastases from renal tumors have been reported in the brain, spine, liver, and many other organs. There are also many cases on record in which lung tumors thought to be primary have proved to be metastatic from the kidney. It is well, therefore, to

consider the possibility of renal neoplasm in every case of lung tumor.

When a renal tumor is seriously suspected, the method of further investigation must be decided upon. Intravenous urography, as stated above, is a most valuable aid in demonstrating certain previously unsuspected renal tumors. In an occasional case the intravenous urogram, with the clinical findings, may tell the whole story, making retrograde study unnecessary (Fig. 1). If, however, there are good grounds for suspecting renal tumor, there are many cogent reasons for omitting intravenous urography and proceeding at once to retrograde study. In the intravenous urogram, delineation of the pelvis is rarely perfect, and seldom good enough to show unmistakably a small and early tumor. Positive or suspicious findings in an intravenous urogram, except under the rare condition mentioned above, necessitate retrograde pyelo-ureterography as well. If the findings on intravenous urography are apparently negative, retrograde study is still necessary before one would dare definitely to rule out a renal tumor. The intravenous urogram, therefore, in practically every case, represents a complete loss of time and money, and in my opinion may well be entirely abandoned as a step in the diagnostic investigation of renal tumors.

Retrograde pyelography is the keystone, the all-important factor, in the diagnosis of renal tumors. Its value rests on the fact that most of these tumors send a process into the pelvis, causing a filling defect, or deform the pelvis in other ways. If these changes are slight, the most perfect delineation is necessary to permit their correct interpretation. These considerations make it essential to procure the most thorough and meticulously planned study.

From the point of view of the urologist, the first important question is which kidney is under suspicion. If bloody urine has been seen coming from one ureter, we know which side to suspect, and may confine the pyelographic study to that side. If both kidneys are under suspicion, there is no longer any reason not to perform bilateral pyelography, unless the patient's general condition is bad or his renal function poor. In any event, both ureters should be catheterized, since, if nephrectomy becomes necessary, the functional capacity of the non-tumor-bearing kidney must be known. This can be determined by functional tests with the ureteral catheters in place. In addition, bilateral pyelography is indicated it there is any reason to think that the non-tumor-bearing kidney is abnormal in any respect. This is especially useful if hematuria and mass turn out to be due to polycystic renal disease.

It has been my custom for many years to confirm the position of the catheter by fluoroscopy, and to make the injection of contrast medium under fluoroscopic observation. Good filling is thus assured. The catheter must be in the pelvis while the pelvis is being filled. It is then with-

Fig. 1. Intravenous urogram. Mr. H., age 54. Painless hematuria at intervals for one year. Very large mass in right kidney region. Chest film clear. In this case the findings justified operation without retrograde pyelography. There were numerous subsidiary tumors in the adjacent peritoneum, perirenal fat, and right adrenal, all of which were removed. Cerebral metastasis developed six months following nephrectomy.

Fig. 2. Bilateral retrograde pyelo-ureterograms. Mr. L., age 47. Typical findings of renal tumor in the left kidney. Bilateral hydroureter and hydronephrosis, due to lower ureteral obstructions. Right ureter dilated systematically after left nephrectomy.

drawn slowly to the lower ureter under fluoroscopic control, making sure that the ureter is well filled. If it cannot be well filled, it may be necessary to substitute a bulb catheter to insure retention of the medium in the ureter.

Stereoscopic anteroposterior films obtained with the patient in a moderate Trendelenburg position are of the greatest value in the diagnosis of renal tumors, and should never be omitted. Since a prompt and positive diagnosis is so important in these cases, I believe that, having gone thus far, other films should be made to eliminate, as far as humanly possible, the chance of missing anything. These are right and left 45-degree oblique films, a lateral film, and one in the erect position. Dr. George Prather has recently called attention to the value of an anteroposterior film taken with the patient lying on his side, with the suspected kidney uppermost. This causes the organ to fall forward and toward the contralateral side and to rotate to some degree. Such a film may well be added. If the abdominal wall is thick, or if all gas cannot be eliminated from the intestine, a pressure bag over the kidney region may improve the delineation a great deal. From these films, if they are well and completely taken, one should be able to make a positive diagnosis, if that be possible. The idea should be to include every possible maneuver at the one sitting, since cystoscopic examinations are far from pleasant, and there is no excuse for subjecting a patient to more of them than necessary. Certainly if the results of such thorough study are negative, there is no need for further examination until some time has elapsed, usually about four weeks.

Two other procedures which have been recommended in the diagnostic study of renal tumors are pneumopyelography and perirenal air insufflation. In rare instances they may be helpful, but it seems to me that their probable advantages are so slight that they in no way compensate for the danger of air embolism inherent in both procedures. For this reason I cannot personally recommend them.

The urologist in his zeal to study the kidney sometimes forgets to order chest films; if so, the roentgenologist should be on the alert to warn him against this serious error. If pulmonary metastases are present, nephrectomy is useless, except in the rare case where there is a solitary deposit in the lung, which may be removed as nearly as possible at the same time as the kidney.

The great importance of the ureterogram depends on the fact that no form of investigation can distinguish positively between parenchymal tumors of the kidney and papillomatous tumors of the renal pelvis. In addition, there may be a primary tumor in the ureter, and none in the kidney. If the renal tumor is papillomatous, failure to remove the ureter containing an implant at the time of the nephrectomy may prove to be a fatal error. Good delineation of the ureter may be difficult but is

Fig. 3. Retrograde right ureterogram. Mrs. W., age 62. Hematuria recurrent after right nephrectomy by another surgeon. This film shows a dilated ureter, with a large filling defect at its lower end.
Fig. 4. Operative specimen, from case shown in Fig. 3, consisting of ureter with papillomatous tumor, and segment of bladder wall. Patient well one year after operation.

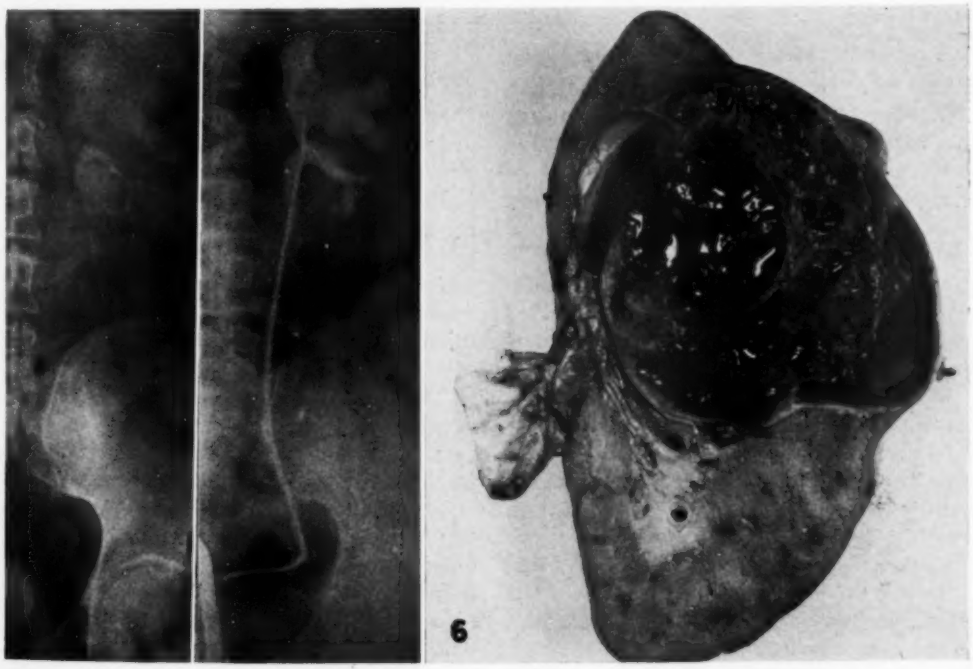

Fig. 5. Intravenous and retrograde pyelograms. Mr. L., age 63. There had been no symptoms whatever. A routine intravenous urogram (left panel) threw suspicion on the left kidney. There was no palpable mass, and the urine was repeatedly found free of blood. The probable diagnosis was simple cyst.
Fig. 6. Operative specimen from case shown in Fig. 5. The cyst wall was everywhere intact, and there was no invasion of the pelvis, but the cyst was filled with tumor tissue (clear-cell adenoma or hypernephroma). The patient is well one year after nephrectomy.

Fig. 7. Intravenous and retrograde pyelograms. Mrs. C., age 38. There had been two attacks of fever, pyuria, and hematuria, separated by a year of perfect health. The urine was clear at the time of examination. No positive diagnosis could be made, but renal tumor was suspected.

Fig. 8. Operative specimen from case shown in Fig. 7. The mid-renal mass proved to be a tuberculoma (chronic thick-walled tuberculous abscess). The pelvis was not involved, but pressure on the infundibula had caused multiple hydrocalycosis. No other evidence of tuberculosis could be found. The patient is well one and one-half years after nephrectomy.

worth the trouble involved. Adequate filling can often be obtained by occluding the lower end of the ureter with a large bulb catheter. Angulations can often be straightened out by placing the patient in an extreme Trendelenburg position and taking the film during expiration. If a tumor-bearing ureter is left behind after nephrectomy, the situation may be clarified by ureterography, as is the case shown in Figure 3.

If, in spite of all efforts, the results of examination are equivocal, there are only two courses open. Either the examination must be repeated in a short time, usually about two weeks, or exploratory operation must be performed. The surgeon must, of course, be responsible for this decision. If there is no mass, and hematuria does not recur, one may wait for a short time and repeat the examination. If, on the other hand, a palpable mass is present, or if hematuria continues or recurs, exploration should not be delayed. Every once in a while a parenchymal tumor, for no apparent reason, does not invade the pelvis, and there will be, therefore, no clear pyelographic evidence of its presence. This situation can be met only by surgical exploration. I recall one case in which renal tumor was suspected, but the pyelogram was normal. Four years were spent waiting for a positive pyelogram, during which time hematuria recurred at infrequent intervals. Finally the surgeon operated, finding a parenchymal tumor 4.0 cm. in diameter. The pelvis had not been invaded, although the tumor was in contact with the upper calyx. Such delay might easily prove to be tragic.

The filling defects and pressure defects which constitute the roentgenologic signs of renal tumor may also be caused by other lesions, in which case a neoplasm must be assumed to be present until proved otherwise. Polycystic kidney can usually be identified for the reason that the pressure defects are multiple and bilateral, but errors can occur. Radiolucent stones and blood clots can produce filling defects.

Pressure defects may be caused by adrenal tumors, pancreatic tumors or cysts, an enlarged spleen, or other lesions external to the kidney. A frequent cause of doubtful findings is solitary cyst of the kidney, but these cases demand exploration, since a renal cyst may contain a malignant tumor (see Figs. 5 and 6). Pressure defects due to carbuncle of the kidney, tuberculoma, aneurysm of the renal artery, and echinococcus cyst may give confusing pictures. Exploration is the court of last resort in such instances.

In conclusion, it may be said that our means for making early diagnosis in renal tumors are imperfect and unsatisfactory, and we can only apply ourselves as earnestly as possible to the use of what we have. Of these means, roentgenologic study is by long odds the most important. It cannot be carried out in its most perfect form without the closest co-operation between roentgenologist and urologist. To this co-operation let us all devote ourselves.

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SUMARIO

Diagnóstico de los Tumores Renales en el Adulto

La pielografía retrógrada es el factor de suprema importancia en el diagnóstico de los nefromas, radicando su valor en el hecho de que la mayor parte de esos tumores lanzan un proceso a la pelvis renal, provocando allí un nicho, o deforman la misma en otras formas.

Las vistas anteroposteriores estereoscópicas, obtenidas con el enfermo colocado en una moderada posición de Trendelenburg, poseen el mayor valor diacrítico, debiendo ser complementadas con radiografías oblicuas derecha e izquierda de 45 grados, una radiografía lateral y una con el paciente erguido. Puede agregarse una radiografía anteroposterior, con el enfermo en decúbito lateral y el riñón sospechoso el más alto. Hay que tomar siempre radiografías torácicas a fin de excluir metástasis.

La gran importancia del ureterograma procede de que ninguna forma de investigación puede diferenciar positivamente los tumores del parénquima renal de los papilomatosos de la pelvis renal. Además, puede haber un tumor primario en el uréter, sin ninguno en el riñón. Si el tumor renal es papilomatoso, la inextirpación de un uréter que contiene un implante al ejecutar la nefrectomía, puede constituir un error desastroso.

Radiologic Diagnosis of Urinary Tract Tumors in Infants and Children[1]

MEREDITH F. CAMPBELL, M.D.

New York, N. Y.

EXCRETORY urography has proved the greatest boon to the study of urinary tract disorders since the invention of the cystoscope. Yet even today in many quarters its limitations are inadequately recognized; in disease of the upper urinary tract, it is decidedly secondary in value and reliability to retrograde pyelography. In the urographic identification of upper urinary tract growths in the young we are concerned chiefly with the mixed tumor of Wilms, the embryonal adenomyosarcoma of the kidney. Excretory urography often suggests the diagnosis, but this is made with far greater accuracy by the employment of bilateral retrograde pyelography. Although new growths of the lower urinary tract are best identified by cystourethroscopic examination, urography (urethrography, cystography, or urethrocystography) may be of considerable aid, particularly in the demonstration of prostatic tumors, in which the elongation, tortuosity, and displacement of the deep urethra are of diagnostic importance.

UROGRAPHIC PREPARATION

Preparation of infants and young children for urography is not as satisfactorily achieved as it often is in adults. We have tried all the recommended procedures but have obtained the best results when the patient was, literally, taken right off the street, with no preparation whatever. In our experience, freedom from gas at any age has been largely a matter of chance; swallowed air is doubtless an important factor in infancy and early childhood. Cleansing of the bowels by laxatives and the withholding of food has, in our experience, only increased the amount of intestinal gas present. Certainly the longer the patient is without food, the greater is the quantity of gas and, for this reason, restriction of eating, chiefly omitting breakfast, has no place in our preparatory schedule. A low enema is desirable, however, to evacuate the rectum and rectosigmoid so that the sacral spine may be shown clearly and congenital defects may be identified. This is of particular interest in the study of neuromuscular vesical disease in the young.

In a series of experimental observations concerning the effect of drugs given to stimulate intestinal peristalsis and the expulsion of gas in preparation for urography, it was found (Campbell, 1941) that the upper urinary tract was also affected. Following the administration of pitressin, for example, the caliber of the renal pelvis and ureter was regularly reduced at least one half, a point of potentially great importance in the interpretation of ureteropyelograms, more particularly of excretory ureteropyelograms. For this reason, the employment of these peristalsis-stimulating drugs is strongly advised against at the time of urography.

While dehydration is of considerable aid in achieving excretory urograms of satisfactory contrast in the adult patient, and may also be employed in older children, withholding of fluids from the young, particularly infants, is not without some danger, especially in the sick child. In infancy, and because of intestinal gas, the small diameter of the lumen of the upper urinary tract, and the rapidity of excretion, intravenous urograms prove to be of no diagnostic value in at least half the cases. Matthei recently discovered by chance that

[1] From the Department of Urology, New York University-Bellevue Medical Center, New York, N. Y. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

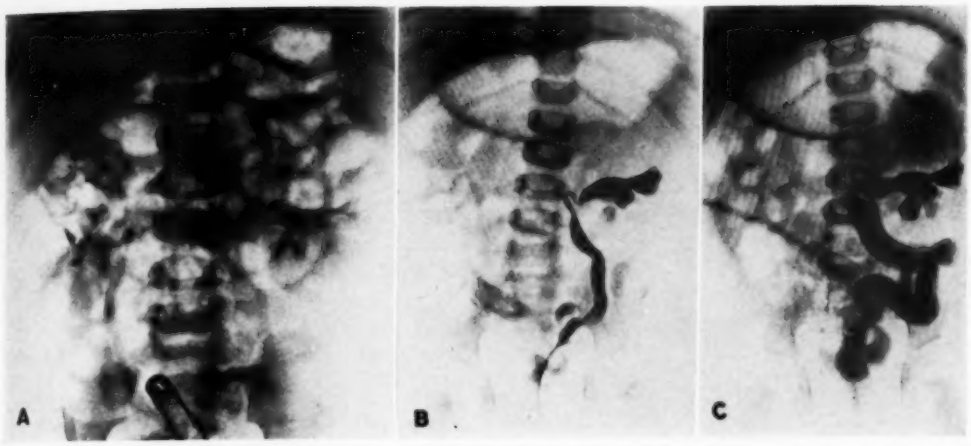

Fig. 1. A. Excretory urogram in two-month-old girl with large mass in left loin. On this basis, a diagnosis of Wilms' tumor was promptly made elsewhere, and the kidney was explored (see text). The faint excretory pyelographic outlines have been lightly traced to make them more obvious.

B and C. Pyelographic and cystographic study of the same child at six months of age, leading to diagnosis of reduplicated left urinary tract. A catheter was passed to the lower renal pelvis and a retrograde pyelogram made; at the same time, the enormously dilated upper renal pelvis and its ureter were demonstrated by cystographic reflux. *Diagnosis:* Infected hydronephrosis and pyonephrosis of reduplicated left renal segment.

the excretory pyelogram in infants was greatly clarified when the child was given 8 or 10 ounces of milk or formula just before the study was made. This produces considerable gastric distention, which in turn pushes the gas-filled intestines downward, leaving a clear field through which the pelves and adjacent ureters are visualized. The ureters, of course, are not shown in the rest of their course. By this method excretory pyelograms of amazing clarity were obtained.

TYPE OF EXAMINATION

In older children the efficacy of excretory urography approaches that observed in adults. Yet when renal tumor is even suspected, the excretory procedure should be supplemented by retrograde pyelography, and in our practice this is routinely bilateral. The following recently studied case illustrates strikingly a possible pitfall when reliance is placed solely on excretory urography.

Fig. 2. Wilms' tumor in a six-week-old girl. A mass in the loin was first felt at five weeks, and a complete urologic examination was promptly carried out, with nephrectomy at six weeks. The patient was apparently well fifteen years later.

The two-month-old daughter of a physician presented a readily palpable mass in the left renal region and fever. An excretory urographic study made in the home city showed the left renal pelvis to be displaced downward, greatly compressed, and transversely flattened (Fig. 1A). Without further investigation, operation for Wilms' tumor was carried out. The kidney did not appear to be tumor-bearing, however; only infected and swollen. A sur-

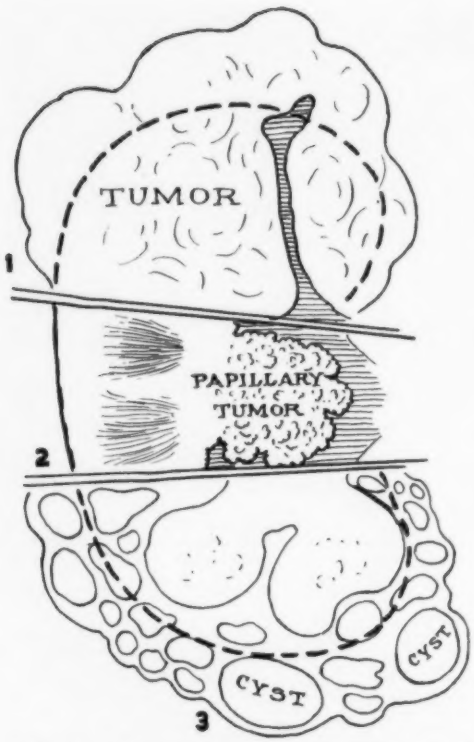

Fig. 3A. Schema of urographic diagnosis in renal and perirenal tumors. 1. Mechanism of production of "spider-leg" pelvis by elongation and compression of the calyces by the renal growth. 2. Filling defect caused by papillary renal or pelvic growths. 3. Globular and crescentic pelvic outlines consequent to polycystic or multilocular cystic renal disease.

gical diagnosis of pyelitis was made, the organ was replaced, and the wound was closed. Subsequently the infant ran a continuous high temperature with pyuria, and a *Monilia* infection was identified. It was then discovered that she also had more than an ounce of residual urine, a contracted bladder outlet, and an extremely edematous generalized cystitis. Considerable improvement followed the use of an indwelling catheter.

I was first consulted when the child was three months old and advised cystostomy drainage, which was followed by remarkable improvement. When she was six months old, we carried out a complete urologic examination. This disclosed a reduplicated left upper urinary tract with a relatively enormous pyonephrosis of the upper renal pelvis (Fig. 1B and C) which had led to the earlier diagnosis of Wilms' tumor. Ureteroheminephrectomy was done, the distended diseased upper half of the kidney and its ureter being removed. Within four days the urine became crystal clear.

This case is cited to emphasize the point that urologic operations performed solely on the basis of excretory urographic findings may become grave surgical errors, as they commonly are.

Only by the retrograde method can the finer markings of the renal pelvis be clearly identified, a matter of great diagnostic importance in many early lesions of the kidney, especially in tumor. Moreover, bilateral pyelography will demonstrate the presence of two kidneys, the architectural integrity of the presumably normal kidney, and especially its freedom from

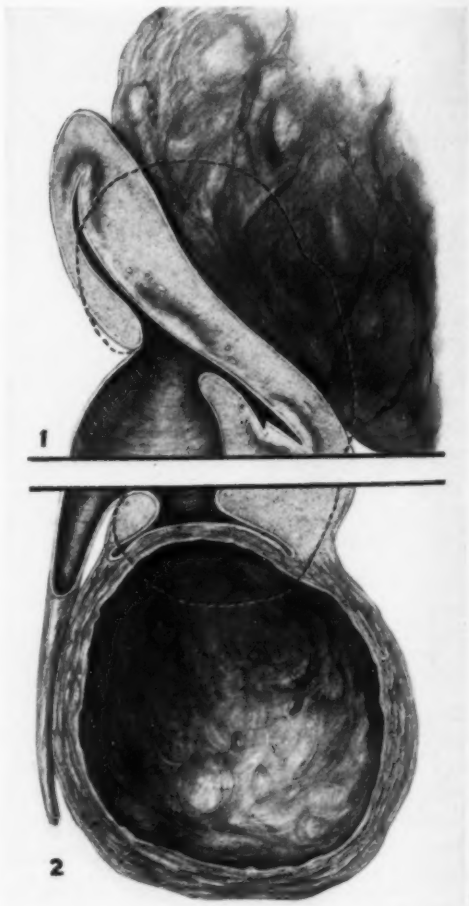

Fig. 3B. 1. Pelvic changes resulting from extrarenal compression. Note flattening and elongation of the pelvis and calyces. 2. Marked pelvic compression by large pelvic cyst.

Fig. 4. Wilms' tumor in a six-year-old boy. Bizarre pyelogram showing enlargement and irregularity of renal pelvis with considerable downward displacement of the kidney. Insert shows compensatory posture of child to accommodate to the renal mass. Nephrectomy. Postoperative recurrence. Death.

Fig. 5. Large renal cyst (500 c.c.) of upper reduplicated left half of a horseshoe kidney in a seven-year-old boy. Abdominal palpation suggested Wilms' tumor. Resection of cyst.

primary or secondary involvement by tumor or other serious disease. Age is no contraindication to retrograde pyelography; I have carried out the procedure in many babies less than one month of age; the youngest with Wilms' tumor was six weeks (Fig. 2).

Fig. 6. Wilms' tumor in four-year-old boy. Loin palpation and the elongated rather smooth compression of the renal pelvis strongly suggested renal cyst rather than neoplasm. Nephrectomy.

In performing excretory urography in the young, we employ diodrast in doses larger than usual. It is preferred to neo-iopax because it causes less venospasm. The intravenous method is not contraindicated by age, illness, or fever. The only contraindication we recognize is failure of the kidneys to excrete or sensitivity of the patient to the medium (iodine). It is important that the urographic exposures be made at much shorter intervals in children than in adults; in infants at intervals of two or three minutes, since all of the medium is commonly found in the bladder in ten to twelve minutes.

THE KIDNEY

In the diagnosis of renal tumor we are concerned with pelvocalyceal changes consequent to neoplastic compression and distortion as well as displacement of the kid-

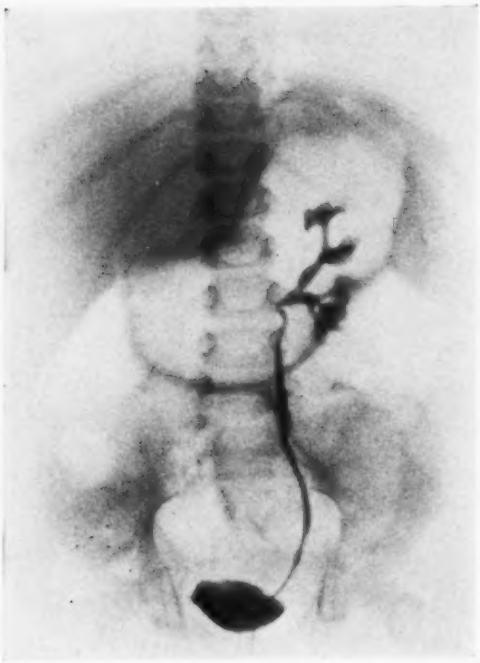

Fig. 7. Left Wilms' tumor in a three-year-old boy who had a large palpable mass in the region of the upper renal pole for four months, which was thought to be an enlarged spleen. In this urogram the outlines are normal. Three months later the mass had grown to enormous size and a pyelogram showed renal tumor. Nephrectomy. Death ten weeks later.

ney from its normal position (Fig. 3). The mixed embryonal tumor (Wilms') is the usual malignant growth of the kidney in the young, and here the changes in pelvic outline are commonly bizarre (Fig. 4). The changes in pelvic outline in the presence of a renal tumor result from (1) mechanical distortion of the pelvis by new growth, (2) obstruction of the pelvic outlet or upper ureter, and (3) ulceration due to infection and/or necrosis. Changes suggestive of renal tumor are elongation of the calyces, filling defect of the pelvis, and enlargement of the pelvis with or without alteration of its capacity.

The most common pelvic deformity in the presence of a renal tumor is a downward, median, or upward compression of the entire renal pelvis consequent to an enlarging mass at the upper, mid, or lower segment of the parenchyma. Such distortions can be described only as irregularly irregular or bizarre. In the early stages, only the calyx or calyces adjacent to the growth show compression, elongation, or distortion. In some instances of Wilms' tumor the pelvic outline suggests a renal cyst, and in two cases thought to be cysts

Fig. 8. Wilms' tumor in two-year-old boy, blotting out all pelvic outlines. The ureter is represented as a thin thread. Nephrectomy.

the mass proved to be a renal embryoma. In a seven-year-old boy with an enormous palpable mass in the upper left loin, the urogram showed a horseshoe kidney with marked downward compression and flattening of the lower half of the left segment (Fig. 5). The diagnosis rested between cyst and tumor, cyst being favored only because of the relative regularity of the outline of the mass. It proved to be a cyst and was successfully treated by resection, with surgical elevation of the remaining renal segment to improve drainage. The cyst held 500 c.c. of fluid. In another

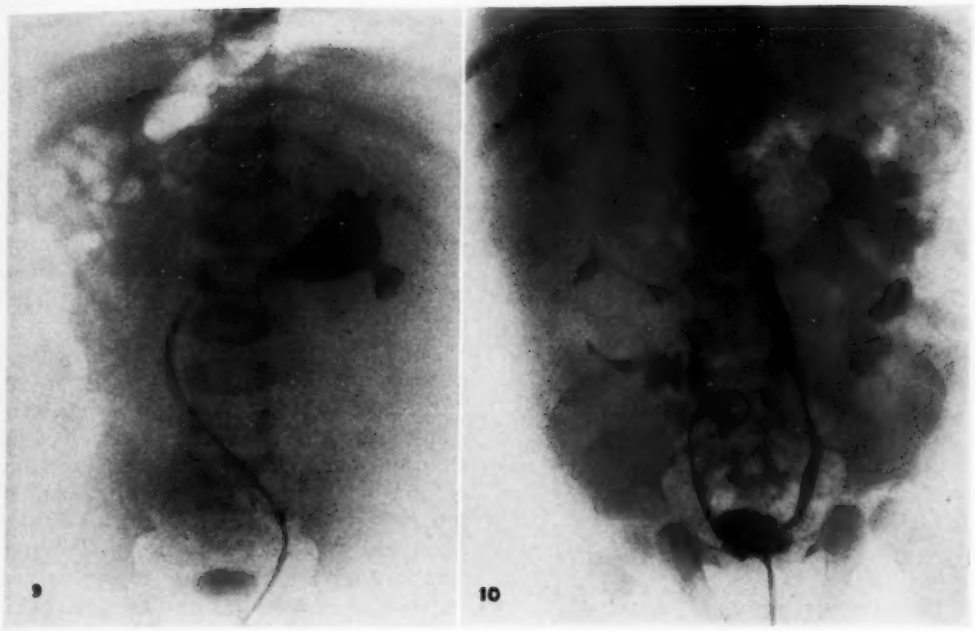

Fig. 9. Wilms' tumor in thirteen-month-old girl. Hydronephrosis consequent to neoplastic obstruction of pelvic outlet. Note wide displacement of the ureter to the right. Nephrectomy. Recurrence.
Fig. 10. Bilateral polycystic renal disease in six-month-old boy, showing bizarre renal deformity consequent to multicystic growth. Uremic death three years later.

child, a five-year-old girl, showing similar compression of the lower pole of the left kidney, the diagnosis again rested between renal tumor and cyst, cyst being erroneously favored in this instance because of the relatively regular concave outline of the compression of the lower pelvic segment. From these examples it is apparent that this criterion is of only suggestive rather than absolute value and that, as in adults, the urographic distinction between a cyst and a malignant tumor is often exceedingly difficult (Fig. 6).

Occasionally the pelvis may show no detectable change even though a fairly large tumor exists (Fig. 7). On the other hand, the tumor growth may completely blot out all pelvic markings (Fig. 8). Moreover, with compression of the pelvic outlet directly by new growth or indirectly by alteration of the renal position with downward sagging, the resulting hydronephrosis may appear to be of the usual variety and fail to suggest the presence of tumor, the only distinguishing feature being the presence of a renal mass far larger than the size of the hydronephrotic pelvis would suggest. Such an instance is shown in Figure 9. The growth was a large fibromyosarcoma of the kidney, which was removed, and the patient is living and well fourteen years later.

In polycystic disease, the pelvic outline is likely to be thoroughly bizarre with compressed "spider-leg" calyces, some ending in bulbous dilatation while others show considerable concentric compression (Fig. 10). Both kidneys are practically always involved, so that the demonstration of bilateral lesions, plus the bilateral palpation of enlarged kidneys, suggests polycystic disease rather than malignant tumor. Moreover, in polycystic disease, the nodular surface of the kidney is often palpable through the abdominal wall. Yet Wilms' tumor, though rarely, may be bilateral, as in 2 cases I have previously reported and in 4 cases seen at the Boston Children's Hospital (Gross, 1949).

In the early stages of hypernephroid or

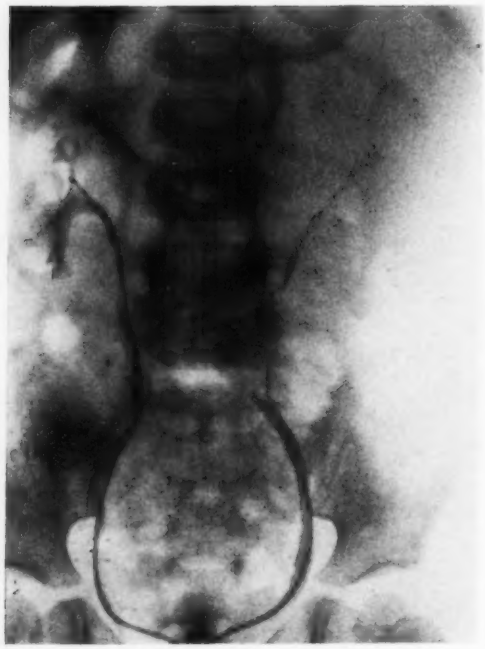

Fig. 11. Adrenal sympatheticoblastoma in thirteen-month-old boy simulating Wilms' tumor and causing elongation and narrowing of the upper ureter with almost complete obliteration of the renal pelvis. There is lateral renal displacement by the tumor.

clear-cell renal carcinoma, usually only one calyx is involved, with an elongation and narrowing of its outline, so-called "spider-leg" pelvis. As the tumor extends, more of the kidney is involved, with comparably greater distortion of the entire pelvic and cortical outlines. These tumors, however, are rare in children, are seldom seen before the age of twelve, and need rarely be considered in the differential diagnosis.

Epithelial tumors of the renal pelvis and ureter are almost unknown in children. As in adults, they may be expected to cause a filling defect in the ureteropyelographic outline. The filling defect is not to be confused with the negative shadow of a non-radiopaque stone, blood clot, air bubble, ureteritis cystica, or pyelitis cystica.

Extrarenal tumors usually cause compression, distortion, and dislocation of the kidney (Fig. 3). Adrenal tumors push the kidney down toward the midline; mesonephrogenic tumors and teratoma tend to push the kidney up or down and, notably, outward (Fig. 11). Yet many unusual forms of renal displacement or compression may be observed, and in perirenal hydronephrosis renal compression and displacement may be extreme. Lateral and lateral oblique views are of special value in these cases of perirenal tumor not only for demonstration of the degree of renal displacement but also for suggestion of the probable site of the growth, its nature, and the organ involved.

In a few cases in which the diagnosis rested between renal neoplasm and adrenal growth, perirenal pneumography has been employed, but in general this method in children is not only unsatisfactory, because of the paucity of perirenal fat, but is infinitely more dangerous than in adults. I have substantially discarded it. Several fatalities have followed its employment in patients of all ages in several clinics, and I have recently heard of one more at one of the better known university clinics, in an eight-year-old girl.

THE BLADDER

Tumors of the bladder in infants and children are rare, they are predominantly myxomatous, grow with amazing rapidity, and are urographically manifested by widespread irregular filling defects. Diminution of bladder capacity corresponds to the growth of the tumor. Most of these tumors spring from the prostatic or trigonal regions and by urethrocystography alone cannot always be differentiated from neoplasms of prostatic origin (Fig. 12).

Epithelial papillary tumors of the bladder sufficiently large to cause a filling defect are practically unknown in the young.

Ureterocele or intravesical cyst of the ureter commonly produces a cystographic negative shadow which, except for its sharply defined smooth outline, might suggest tumor. A large ureterocele may nearly obscure the cystographic outline, which may be defined only by a concentric halo of radiopaque medium surrounding an enormous filling defect (Fig. 13). Ureterocele is the most common intravesical

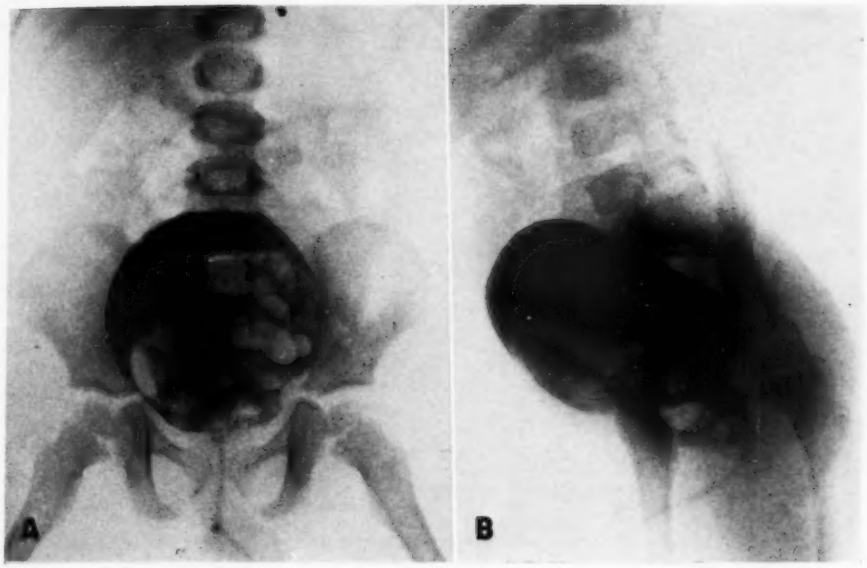

Fig. 12. Leiomyosarcoma of the bladder in a four-year-old boy. Symptomatic onset four weeks before, with urinary difficulty, promptly followed by chronic complete retention. A. Bladder nearly filled by the large and innumerable whitish grapelike tumor clusters. B. Lateral view showing extensive vesical tumor filling defect. Permanent suprapubic cystostomy drainage. Death four months later.

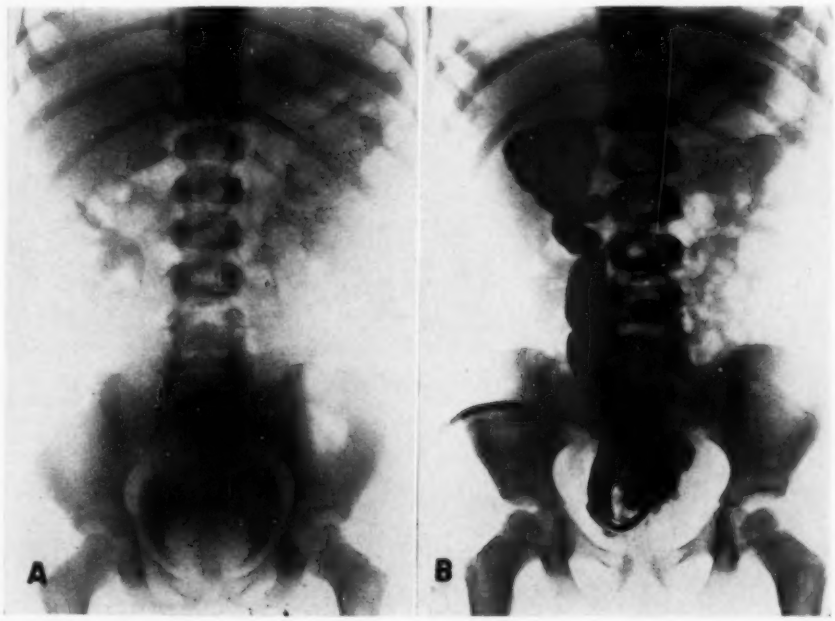

Fig. 13. Large ureterocele causing urinary difficulty in a three-year-old child examined because of vesical distress and persistent pyuria. A. The ureterocele is outlined as a filling defect at the bladder base (excretory cystogram). B. Reduplicated right upper urinary tract; the ureter from the upper renal pelvis opened into the ureterocele; the ureter to the renal pelvis was normal. Ureteronephrectomy. Transurethral ureterocelectomy.

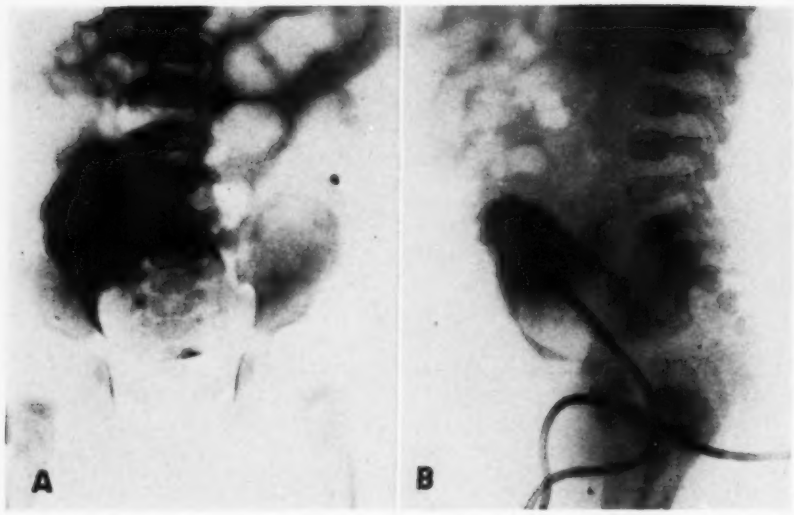

Fig. 14. Ureterocele extensively filling the bladder of an eleven-month-old boy with marked urinary difficulty and chronic urinary infection. He could urinate only in the knee-chest position which caused the ureterocele to fall away from the vesical outlet. A. Extensive globular filling defect in lower segment of bladder due to ureterocele. B. Lateral cystogram showing size of ureterocele.

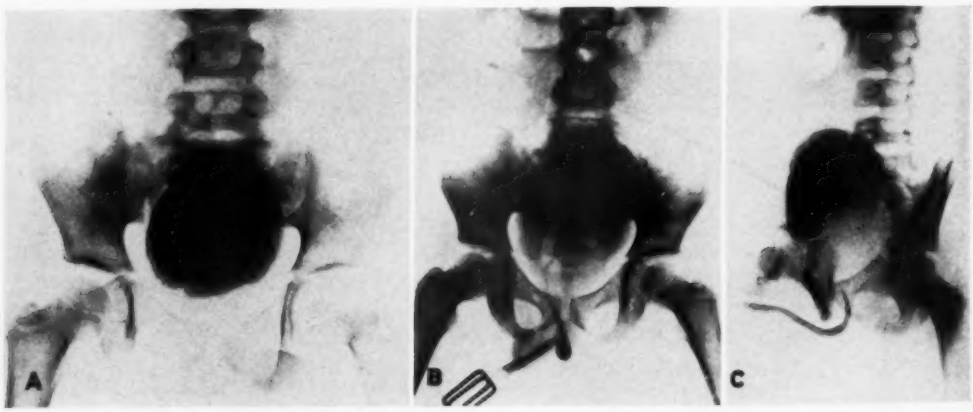

Fig. 15. Fibrosarcoma of the prostate in a five-year-old boy with urinary frequency and difficulty for three weeks before the above cystogram (A) was made. There is slight cystographic irregularity and a filling defect at the vesical outlet. B. Pronounced filling defect of vesical outlet by prostatic tumor with elongation of the prostatic urethra and marked deviation to the right. C. Oblique cystogram showing pronounced filling defect of the vesical outlet and lower half of the bladder caused by the tumor. The cystograms shown in B and C were made only three weeks after that in A and indicate the extremely rapid growth of the neoplasm. Cystoprostatectomy with bilateral cutaneous ureterostomy. Death two weeks later of hyperacute left suppurative nephritis which demanded nephrectomy.

swelling in the young, in whom the condition is congenital. It is not unusual and may extend down to block the vesical outlet by ball-valve formation (Fig. 14) or, in the female, may prolapse through the urethra.

THE PROSTATE

Prostatic tumors in the young are extremely rare; they are predominantly sarcomatous and are rapidly fatal. Cystic prostatic tumors are generally congenital and are occasionally seen. I have en-

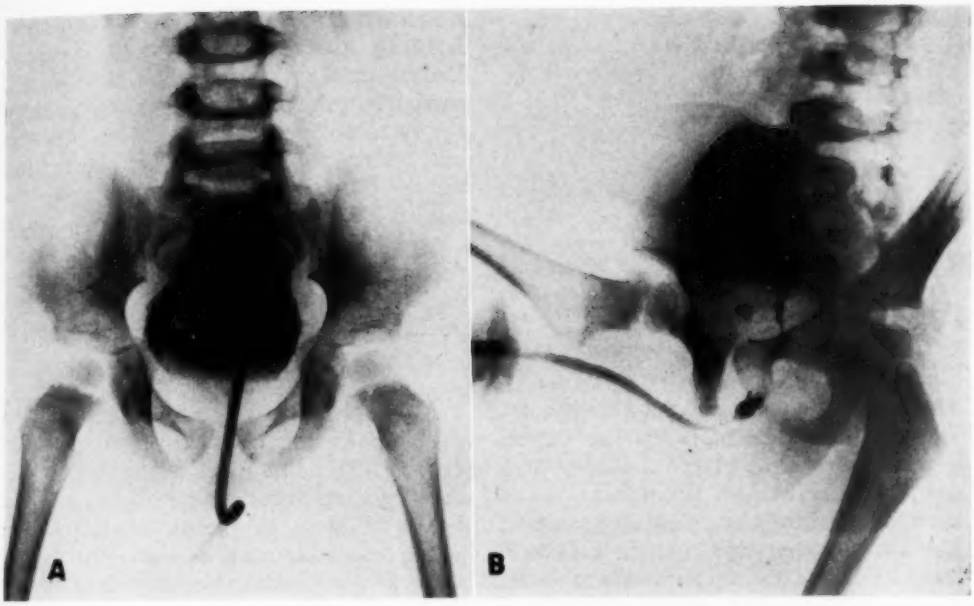

Fig. 16 A. Fibrosarcoma of the prostate in two-year-old-boy with acute retention for two weeks; indwelling catheter drainage. There is a moderate filling defect of the lower half of the bladder with some trabeculation. B. Oblique urethrocystogram indicating filling defect of the inferior segment of the bladder with elongation and tortuosity of the prostatic urethra. The absence of globular growth into the bladder is notable. C. Upper urinary tract of same patient. Retrograde pyelograms made through catheter drainage tubes in bilateral cutaneous ureterostomy. Eight months later there is no evidence of recurrence of sarcoma. If none appears within another six months, ureterosigmoidostomy will be performed.

countered but 4 instances of prostatic sarcoma in boys under six years and in the past year have carried out radical cystoprostatectomy with cutaneous ureterostomy in 2 (Fig. 15). Sarcoma of the prostate is an unusually rapidly growing tumor. The most common type is fibromyxosarcoma, although leiomyosarcoma is occasionally seen. The prostate enlarges to ten to twenty times its normal size, with elongation, distortion, and irregularity of the prostatic urethra which is readily demonstrable by cystourethrography, as is extension of the tumor into the bladder (Fig. 16). In the last circumstance, the differentiation from vesical tumor is sometimes difficult and must depend on cystoscopic observation or even histologic study.

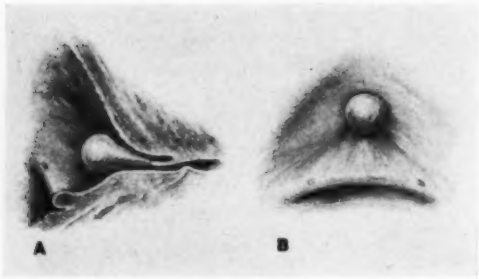

Fig. 17 A. Ball-valve polyp springing from the roof of the prostatic urethra in an eleven-year-old boy. The polyp extended into the vesical outlet to cause pronounced obstruction as shown in B.

In performing urethrocystography, the exposure should be made in the anteroposterior as well as in the lateral-oblique positions. In the last, the patient should lie on his side in the bicycle-riding position, that is, with the under thigh and knee flexed high and the upper thigh extended well back. In performing urethrography we employ diodrast, skiodan, or neo-iopax in full ampule strength, injecting 4 to 10 c.c. according to the age and size of the young patient. More viscous media, including rayopake, have been endorsed by others, but with us the excretory urographic medium in full strength has been generally satisfactory.

THE URETHRA

Urethral tumors are seldom seen in the young. I have encountered only one which was large enough to have been satisfactorily delineated by urethrography. Unfortunately this examination was not carried out, the diagnosis having been made by cystourethroscopy (Fig. 17). In this case a large polypoid tumor springing from the distal roof of the prostatic urethra extended back into the vesical outlet to cause obstruction. Other urethrographic filling defects in the urethra usually indicate the presence of stricture; urethrographic outpocketings denote urethral diverticulum.

CONCLUSIONS

Although urography may be expected to suggest the diagnosis in most cases of urinary tract tumors in the young, thorough cystourethroscopic study is advised before surgical treatment is undertaken. When the problem is one of renal tumor or any other serious upper urinary tract disease, diagnostic reliance should be placed on retrograde rather than excretory pyelography. Yet we routinely employ excretory urography as a "scout" study preliminary to cystoscopic investigation. Surgical treatment is carried out on the basis of excretory findings only when retrograde pyelography is technically impossible because of inability to catheterize the ureter, as in some cases of renal tuberculosis or congenital ureterovesical junction stricture.

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SUMARIO

Diagnóstico Radiológico de los Tumores del Aparato Urinario en los Niños

En la identificación urográfica de los tumores de la porción superior del aparato urinario en los niños, nos interesa principalmente el tumor de Wilms. El diagnóstico es a menudo indicado por la urografía excretoria, pero se hace con exactitud mucho mayor por medio de la pielografía retrógrada. El examen debe ser bilateral, para comprobar la presencia del segundo riñón y cerciorarse de la integridad anatómica y normalidad del mismo.

Alteraciones indicativas de nefroma son: alargamiento de los cálices, nicho de la pelvis renal e hipertrofia de la pelvis renal con o sin modificación de su capacidad. Los tumores extrarrenales pueden ocasionar compresión, distorsión y dislocación del riñón.

Aunque las neoplasias de la porción inferior del aparato urinario son mejor identificadas por el examen cistouretroscópico, la urografía puede ser de mucha ayuda en el descubrimiento de tumores prostáticos, en los que el alargamiento, tortuosidad y desplazamiento de la uretra revisten importancia diagnóstica.

DISCUSSION

(Papers by Meredith F. Campbell, M. D., and David M. Davis, M. D.)

George W. Chamberlin, M. D. (Reading, Penna.): Dr. Campbell and Dr. Davis have presented an excellent symposium on the subject of renal tumors. Neither of them has said anything to which I can seriously object, but perhaps I may emphasize some of the points which they have made.

I think that we all agree that good roentgen technic is fundamental to proper diagnosis. I agree with Dr. Campbell that in children, as a rule, no special preparation is necessary, except a low enema. Our experience with the subcutaneous injection of dye has not been satisfactory even when we have used hyaluronidase to increase the speed of absorption. Therefore, we always attempt the intravenous method. One can usually find a vein even in the very young infant, either in the scalp or in the neck, into which neo-iopax can be injected. In accordance with Dr. Campbell's suggestion, we have used a larger amount of dye in proportion to the size of the patient than is usually given in adults. In children the films are made at frequent brief intervals and we believe that we can obtain more diagnostic information if we use both the supine and the prone position.

In adults I have found it easier to obtain films of good diagnostic quality with excretory urography than with retrograde study. I think this is largely due to the fact that the patients undergoing the intravenous study are not experiencing pain from recent catheterization and cystoscopy. They are not under the effect of any anesthetic, and the technic does not have to be hurried as it frequently must be when the dye is injected in a retrograde manner. This does not mean that excretory urography is the superior method. I agree with Dr. Davis as to its definite limitations. Being a physiological procedure, it depends upon renal function; where function is interfered with, morphology is lost. In spite of this fact, it is sometimes amazing to see a kidney extensively involved by tumor which nevertheless has produced a fairly decent intravenous pyelogram. This is in contrast to acute infectious lesions, which may seriously influence the excretory pyelogram, even though only a small amount of the kidney may be involved. In our department the two methods of roentgen examination are used to complement each other, and we try to use that procedure which under the circumstances will give the quickest and best results.

Dr. Davis has pointed out the clinical signs and symptoms which lead one to suspect the diagnosis of renal tumor. I would like to add to his list the presence of "fever of unknown origin." We have recently seen two patients with an unexplained fever. Both these patients were subjected to rather thorough study but, because the routine urine analysis showed normal findings, the question of kidney tumor was not suggested until considerable time had been lost. One patient had a renal-cell carcinoma; the other had a lymphosarcoma which, as far as we can tell at present, was localized in the left kidney.

In the analysis of the films of the urinary tract for renal tumor there are five points with which the radiologist should be thoroughly familiar:

(1) It is important to look at the outside shadow of the renal parenchyma as well as the shadow of the dye-filled portions of the kidneys. The kidney involved by tumor is almost always enlarged, and such enlargement may be either localized or generalized.

(2) The greatest amount of renal torsion is produced by intrarenal lesions. Dr. Campbell has mentioned this in connection with Wilms' tumors in children; it may also be true of renal parenchymal tumors and cysts in adults.

(3) Apparently, circumscribed tumors of the kidney are not necessarily benign. As Dr. Davis has already mentioned, the differential diagnosis of benign renal cyst and cystic hypernephroma is extremely difficult and sometimes impossible.

(4) Amputation of a calyx is almost always pathognomonic of renal carcinoma. As far as I know, there is only one exception to this, and that is in the rare event of constricting pyelonephritis. In this instance the kidney is small compared to the tumor-bearing kidney.

(5) Blood in a kidney pelvis must be differentiated. In these instances the pyelogram shows a filling defect which could be interpreted as tumor or blood or both. The kidney parenchyma may show no enlargement or abnormal bulging. Irrigation of the pelvis of the kidney is not successful in removing the filling defects, and the question of nephrectomy for papillary carcinoma of the pelvis is considered. In a few such instances we have found a perfectly benign condition, namely, acute hemorrhagic papillitis. Fortunately, this is not common. Sometimes it is bilateral, which helps us to make a diagnosis. In one patient in which rather massive unilateral hemorrhage was present, the kidney was removed for a suspected tumor only to reveal acute hemorrhagic papillitis, and the patient returned to the hospital six months later with bleeding from the opposite kidney. These cases present us with a rather difficult diagnostic problem which I have not been able to solve in my own experience. However, in the last analysis one should remember that it is better to sacrifice a few kidneys showing hemorrhagic papillitis than to neglect removing one single malignant tumor.

David M. Davis, M. D. (*Closing*): I think that the question of pyelography in suspected Wilms' tumor is one that can be discussed pro and con at great length. After all, omission of a retrograde pyelogram implies a certain assumption that we already know what the disease is and, as circumstances are, the assumption is usually correct. However, I think that, owing to the fact that retrograde pyelograms have been taken in such a very small percentage of Wilms' tumors, we may not know just how much help we might get from them. I would say that the principal argument for performance of retrograde pyelography, in so far as we know about it at present, is merely that it permits us to accumulate a volume of experience. Looking at these pyelograms we can see what they show and whether what they show is of any importance to us or the patient, and can also find out just exactly how many times we may be mistaken in our assumption that we are dealing with Wilms' tumor.

I, personally, have seen two cases of clear-cell carcinoma, one in a year-old baby and one in a little girl of seven, so that they can and do occur, although it is true that they are quite rare.

In regard to Dr. Chamberlin's discussion, I have no criticism of anything that he has said except that I cannot help but feel that his urological cooperation is to be criticized. Certainly, it is the duty of the roentgenologist to take good pictures and to help in the interpretation. It is the duty of the urologist to provide the roentgenologist with the subject in the proper posture and condition to allow the best possible roentgenographic studies to be made. I see no reason, *no reason*, why the films with catheters in place in the renal pelvis should not be taken under the best possible conditions. There is no reason why the patient should be squirming in agony. With proper local anesthesia, with proper introduction of catheters, with proper introduction of contrast medium, with the aid of gravity and not syringes (where the amount of force to be applied cannot be determined), there is no reason why the patient should not be exactly as comfortable and cooperative as during intravenous urography. This is the duty of the urologist and, if he does not perform it, he places the roentgenologist at a disadvantage. I think that is all I need to say about that.

The question of the cutting off of the calyx is an interesting one because there are numerous causes for this apart from neoplasm. If you will remember, in the case of tuberculoma there was infundibular compression in all parts of the kidney, leading to a multi-hydrocalycosis. Inasmuch as the principal lesion was more or less spherical, a good part of this must have been caused by the associated inflammatory changes. Such changes can, however, be confined to a single calyx, and we have seen a number of cases in which we could not figure out why the calyx was either stenotic or completely occluded. There were cases in which there was no history of any sort of inflammatory change and certainly no neoplasm, so we had to think that there may be cases with congenital stenosis of the infundibulum. Of course, such a condition may give rise to a solitary hydrocalycosis. The calyx may become infected, a stone may form in it, and secondary inflammatory changes may be superimposed on the original condition. If there has been a complete occlusion, the calyx cannot be demonstrated either by intravenous or retrograde pyelography.

Finally, in regard to the question about the last specimen: it was difficult for me to see from the pathological specimen just what had produced the picture shown in the pyelogram. One can only assume that the irregularity was due to the presence of blood clots. The filling defects, as I recall them, were entirely on the medial side of the pelvis, which again is against renal neoplasm. It is possible to conceive of a papillary pelvic tumor springing from the medial aspect of the pelvis; for some reason, they usually occur on the other side and, of course, the filling defect arising from parenchymal tumors is pretty nearly bound to be on the lateral side.

I noticed, also, that the catheter in use was a pointed type of catheter and that irrigation of the renal pelvis was not found to be possible. I presume that the catheter had been advanced somewhat further during the effort to irrigate. Of course, one of the principal causes of inability to irrigate freely is the presence of blood clots, and it may very well be that was the reason why this pelvis could not be irrigated and that the blood clots caused the irregularities in the pyelogram. In view of the fact that there is such a possibility, the diagnosis of renal tumor would seem to be sufficiently doubtful that one might well make a little more effort to elucidate the problem. I think probably the question would have been answered by a second pyelogram.

I have, of course, made a plea for not repeating cystoscopic examination, but only when it is not necessary to repeat. In a case like this, it is necessary to repeat it and it might be repeated within twenty-four hours, when one might find an entirely different outline. Of course, it could be argued that it is better to sacrifice an occasional sound kidney than let a malignant neoplasm go. Even if we grant that, I don't think we have any right to sacrifice a healthy kidney until we have made the most serious and earnest effort to find out whether it needs to be sacrificed.

I have known of several cases where essentially healthy kidneys were sacrificed on account of a diagnosis of neoplasm or tuberculosis. It seems to me, in almost every case I remember, that, if the study had been carried further and done more carefully, perhaps this need not have happened.

Diastematomyelia

Transfixation of the Cord or Cauda Equina with Congenital Anomalies of the Spine[1]

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DIASTEMATOMYELIA is a congenital malformation of the neural axis characterized by a sagittal division of a segment of the spinal cord or cauda equina and usually associated with anomalous development of the vertebrae. The two lateral portions of the cord are separated by an osseous or fibrocartilaginous septum which is attached anteriorly to one or more vertebral bodies, posteriorly to the dura, and occasionally to the deformed vertebral arches as well.

Herren and Edwards (3) were able to collect from the literature 42 cases which they considered examples of true diplomyelia and added another. Since then we have found 9 additional reported cases (1, 2, 5–9). In 1946, Maxwell and Bucy (8) stated that only 4 of the recorded cases were diagnosed before autopsy; these were recognized at operation. No reports have been found of cases in which the diagnosis was made preoperatively. We believe that the diagnosis can be made in most cases by roentgenograms of the spine because of the associated bony abnormalities. It is the purpose of this paper to present the roentgen criteria for such a diagnosis.

Roentgenograms of the spine will be fully described later. In essence, they show a fusiform widening of the interpedicular spaces over several spinal segments. Most of our cases also show an osseous spur in the approximate center of the widened spinal canal, best seen in the anteroposterior projection. Myelograms have been obtained preoperatively in 7 patients and all have shown a filling defect of the pantopaque column at the midline bony spicule. At operation, this bony spur proved to separate the two portions of the spinal cord and to be attached to the posterior surface of the vertebral body.

Twelve cases of transfixation of the neural axis have now been proved by operation at The Children's Hospital of Boston. In 10 the diagnosis was made preoperatively. Six other patients suspected, on the basis of the roentgen findings, of having diastematomyelia are awaiting operation. Nine of the proved lesions occurred in the cord and 3 in the cauda equina. They are grouped together because embryologically, clinically, and roentgenologically they appear similar.

The osseous or fibrocartilaginous septum passing through the cord or cauda equina fixes the cord in a low anatomical position, so that its normal ascent during growth of the bony spine is impaired. This septum, and the arachnoid adhesions which frequently accompany it, produce traction on the cord or cauda equina that results in neurologic disturbance and in many reported cases has led to the Arnold-Chiari malformation and hydrocephalus, although in our series only one patient exhibited hydrocephalus secondary to an Arnold-Chiari deformity.

Diastematomyelia is most frequently observed in the lumbar region. We have, however, seen it as high as the level of the seventh thoracic vertebra.

This lesion is clinically significant, as nearly all of the patients have shown evidence of impaired innervation to the lower extremities or disturbance of sphincteric control. At birth, there may be a cutaneous defect suggesting spina bifida, such as excessive hair, a skin dimple, or nevus. One of our patients had a meningocele,

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and the association of meningocele and diastematomyelia has been reported (10). Usually, no abnormality of either lower extremity is observed at birth, but the patient fails to walk properly at the expected time, or a limp develops during the first several years of life after the child has learned to walk correctly. An abnormal gait is the most frequent initial complaint, and following its recognition, a physical examination usually reveals some abnormality of one or both legs. Atrophy of one or both lower extremities is frequent. One foot may be significantly shorter than the other, or may show such deformity as talipes, metatarsus varus, or pes cavus. The deep reflexes of the lower extremities may be either hyperactive, diminished, or absent. Ankle clonus and dorsiflexion to the Babinski stimulus may be present. Occasionally there is hyperesthesia of the skin of the legs. Urinary incontinence is not uncommon.

ROENTGEN DIAGNOSIS

Roentgenograms of the spine show, at the level of diastematomyelia, widening of the neural canal and the interpedicular spaces which may extend over three to six adjacent spinal segments (9). The involved pedicles are not narrowed and hence suggest congenital widening of the spinal canal, rather than recent pressure erosion such as results from an expanding intraspinal tumor. When the septum which divides the cord is osseous, it is best seen in a film made in the anteroposterior projection and may be recognized as a small linear or irregular fragment of bone lying in the midline of the neural canal. It is rarely more than 1.0 or 1.5 cm. in length and occasionally is much smaller. Only rarely can this osseous spicule be recognized in the lateral projection, but on occasion it can be seen arising from the posterior surface of the vertebral body or lying in the posterior part of the neural canal in close association with the lamina.

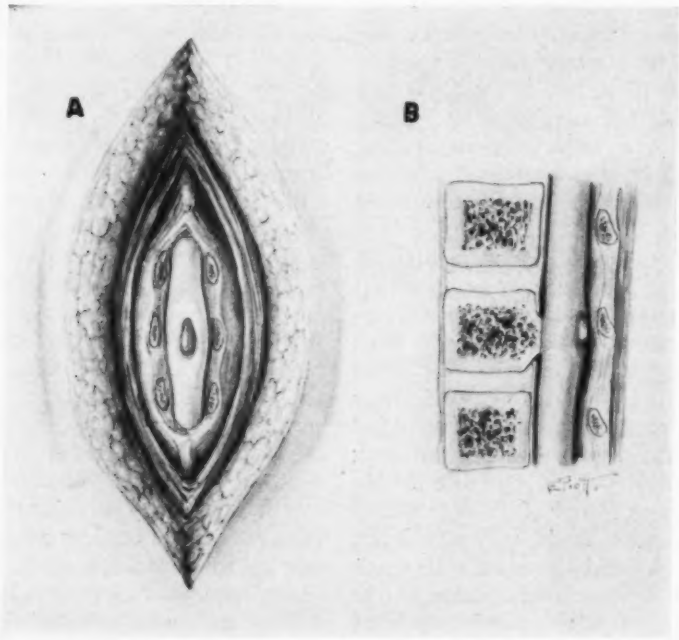

Fig. 1. Diastematomyelia exposed at operation. Showing widening and division of the cord by the transfixing bony spicule, and the attachment of the spicule anteriorly (B).

Fig. 2. R. C., a boy aged four years and eight months, with slight atrophy of the right leg, a pigmented nevus over the lower dorsal spine, and difficulty in walking for three months. The roentgenogram shows widening of the neural canal, D-8 to L-1, double hemivertebra and bony spicule at D-11. Proved at operation.

Fig. 3. J. M., a girl of one year and eleven months, unable to walk alone, presenting weakness of the left leg and bilateral positive Babinski reflexes. There is scoliosis; D-7 is a double hemivertebra; the neural canal is widened from D-7 to D-10 and a longitudinally placed osseous spur is present at D-8. There is a gross lumbar spina bifida occulta. Diastematomyelia proved at operation.

Fig. 4. G. D., a girl eleven and a half years old, with weakness, atrophy and slight sensory loss in the right leg and a midline dimple in the lower lumbar region. The roentgenogram shows a spicule 1.5 cm. in length at L-4, spina bifida occulta, and widened neural canal. Operation showed the spicule transfixing the cauda equina.

Fig. 5. Myelogram of patient shown in Fig. 4, confirming the presence of the transfixing bony spur at L-4 producing a small linear defect in the pantopaque column.

Fig. 6. R. A. Lateral film of the spine in a girl with proved diastematomyelia and transfixation at D-11, showing underdevelopment of D-11 and diminution in the anteroposterior diameter of D-10, D-11, and D-12. The intervertebral spaces are narrow.

In addition to the widened spinal canal and midline bony spicule, various other anomalies of the vertebral bodies and arches usually exist, especially at or near the area of diastematomyelia. Diminution of the anteroposterior diameter of the vertebral bodies is frequent. Double hemivertebrae are occasionally present. Several bodies may be unsegmented or hypoplastic, with narrow intervertebral spaces, resulting in kyphosis and scoliosis. The vertebral arches are often bizarre, and overgrowth posteriorly may be seen in the lateral view. Abnormal fusion of the lamina is not infrequent. It may take the form of diagonal fusion of contralateral halves of adjacent vertebral arches or of fusion of adjacent arches on one side. Lack of normal fusion with resulting spina bifida is usual.

If the osseous spicule can be seen lying within the widened neural canal, it is probable that myelography is not necessary to establish the diagnosis. However, it is usual on myelography to find that associated with the bony spicule there is unsuspected fibrous or fibrocartilaginous tissue further widening the septum, and arachnoid adhesions with resulting deformity of the pantopaque column have been observed. The septum itself produces a small rounded or irregular elongated filling defect in the central portion of the opaque column, and on spot films within this defect may be seen the spicule itself.

In those patients that exhibit widening of the neural canal associated with anomalous development of the vertebrae, but without a recognizable bony spicule, myelography should be carried out, as a considerable number of these patients have non-opaque septa (3).

With increasing age of the patient, it is probable that the diagnosis of diastematomyelia from either plain films or myelograms becomes more difficult, as the associated abnormalities of the bony spine result in progressive kyphoscoliosis, so that in later childhood or in adult life the typical roentgenologic findings are masked by the associated rotation, curvature, and foreshortening of the spine.

DIFFERENTIAL DIAGNOSIS

It is probably true that there must be widening of the spinal canal in the area of the diastematomyelia. One patient was observed at this hospital in whom the myelogram revealed a constant filling defect in the pantopaque column identical with the defect observed in patients with diastematomyelia, but roentgenograms of the spine showed no widening of the spinal canal or other congenital anomalies. At operation this patient was found to have only a fibrous scar from arachnoiditis surrounding an otherwise normal cauda.

An expanding intraspinal tumor probably represents the greatest problem in differential diagnosis. Tumors, however,

that spread the pedicles are apt to narrow them as well as erode the posterior portions of the vertebral bodies. These changes have not been observed in diastematomyelia.

The widened neural canal of diastematomyelia may be simulated by intraspinal meningoceles or lipomata, except that the midline osseous spur or fibrocartilaginous septum will not be present.

Fig. 7. D. L., a five-month-old female infant with a midline hairy nevus in the lumbar region. Myelogram showing an osseous spicule lying within the linear defect in the column. There is marked widening of the neural canal. The spicule transfixed the cord.

The associated congenital anomalies of the vertebral bodies and arches seen in diastematomyelia are probably of little differential diagnostic value. They may also occur with intraspinal dermoids, lipomata, and meningoceles. When the midline bony spur is present in the area of widening of the interpedicular space, the diagnosis should be obvious. Herren and Edwards (3) found, however, that in three-fourths of their series the septum between the two portions of the cord was fibrous or cartilaginous tissue with no bony component. At present we have recognized by roentgenogram only those cases in which it contained bone. By myelography we have identified one case with a fibrous septum. In the future perhaps the condition will be suspected in those cases with a non-osseous septum because of the characteristic widening of the spinal canal in association with other congenital anomalies of the bony spine. Myelograms on such patients should reveal the correct diagnosis.

Fig. 8. R. R., a boy of four years and ten months, with weakness of the right leg of one month duration. Spina bifida, anomalous vertebral development, and widened neural canal were recognized, but no bony spicule could be seen. The myelogram shows a small rounded defect at L-4 produced by a fibrous septum through the cauda equina.

SURGICAL TREATMENT

In order to prevent symptoms or stop the progression of those already present, the operative removal of the midline septum seems logical because it removes the fixation and compression of the cord or cauda equina. A detailed report of the

clinical manifestations, surgical treatment, and subsequent course of these patients has been prepared for publication elsewhere (4).

SUMMARY

Diastematomyelia is an embryological defect of the neural axis and spinal column with a sagittal division of a segment of the cord. The cord or cauda is transfixed by an osseous or fibrocartilaginous septum. The roentgen changes of widening of the neural canal, abnormally developed vertebrae, and a midline osseous spicule are characteristic. In the presence of a fibrous or cartilaginous septum, the diagnosis must be confirmed by myelography. The abnormality is not uncommon. It is clinically significant and is susceptible to surgical treatment.

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SUMARIO

Diastematomielia: Transfijación de la Médula Espinal o la Cola de Caballo con Anomalías Congénitas del Raquis

La diastematomielia o diplomielia es un vicio embriológico del eje cefalorraquídeo y de la columna vertebral con una división sagital de un segmento de la médula, estando bien la última o la cola de caballo transfijada por un tabique óseo o fibrocartilaginoso. Son típicas las alteraciones roentgenológicas, consistiendo en ensanchamiento del conducto neural, desarrollo anormal de las vértebras y presencia de una espícula ósea en la línea media. Si hay presente un tabique fibroso o cartilaginoso, el diagnóstico tiene que ser confirmado con la mielografía. La anomalía no es rara, poseyendo importancia clínica y prestándose para la cirugía.

En el hospital de los AA., observáronse 12 casos comprobados al operar, en 10 de los cuales el diagnóstico acertado fué realizado preoperatoriamente.

Treatment of Leukemia and Allied Disorders with Folic Acid Antagonists; Effect of Aminopterin on Skeletal Lesions[1]

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THE TERM "chemotherapy" was introduced by Ehrlich to indicate the treatment of parasitic disease by direct chemical attack upon invading organisms. More precisely, the goal of chemotherapy has been defined as the killing of pathogenic forms of life with a *minimum* of effect upon the tissues and physiologic processes of the host (6). In a restricted sense, chemotherapy is directed against pathogenic organisms—viruses, fungi, bacteria, spirochetes, protozoa, and helminths. If the words "parasitic disease" in the definition above are interpreted broadly, we can add to the list of chemotherapeutic agents those substances used in the treatment of neoplastic disease. The basic goal of affecting the "parasite" with a minimum of effect upon the host is not lost. Many so-called carcinolytic agents have been described and used. These have included the products of micro-organisms (toxins, polysaccharide extracts, etc.), immunologic preparations (antireticular cytotoxic serum), hormones, and various chemicals (urethane, stilbamidine, nitrogen mustards).

It is the purpose of this paper to review briefly available information on the use of a group of chemotherapeutic agents currently employed in the treatment of leukemia, and to describe alterations in roentgenograms of the skeleton of leukemic children treated with aminopterin.

FOLIC ACID CONJUGATES

Some carcinolytic agents have come into the domain of cancer therapy from apparently unrelated fields. Such is the history of the use of aminopterin and allied compounds, which have come to us indirectly from the field of nutrition.

Studies of the vitamin B complex resulted in the separation of folic acid—pteroylglutamic acid or PGA—which has been found to affect erythropoiesis as well as to constitute a factor necessary for the growth of certain micro-organisms. *Lactobacillus casei* is the organism generally used in the bio-assay of folic acid, and the compound is therefore known as the *L. casei* factor.

The observation that extracts of barley and brewer's yeast seemed to cause regression of experimental mouse neoplasms led to the identification of a compound which not only caused definite regression of tumors, but which was found to act like the *L. casei* factor. This compound proved to be not folic acid but a conjugate of folic acid with two additional molecules of glutamic acid (teropterin). Folic acid was not effective as a carcinolytic agent (8). Teropterin was then synthesized and added to the armamentarium of experimental cancer therapy. In the course of synthesis, the di-glutamic conjugate (diopterin) was produced and found to be effective, also (Fig. 1). Folic acid (pteroylglutamic acid or PGA) is formed by the union of the cyclic compound pteridine with para-amino-benzoic acid and one molecule of glutamic acid. The other two compounds, diopterin and teropterin, are characterized by the presence of two and three molecules of glutamic acid, respectively, in place of the single molecule in folic acid.

Farber and his associates applied the data from experimental studies to the treatment of neoplastic disease in man (2). Because of the completely experimental nature of the drugs, treatment was attempted only in hopeless cases, so that

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the results are far from conclusive. The conditions treated included acute leukemia, carcinoma of many body systems, Hodgkin's disease, lymphosarcoma, osteogenic sarcoma, Ewing's tumor, brain tumors, tumors of muscle and cartilage, and embryomas of the kidney. The duration of treatment ranged from a few days to five months, with an average of five weeks. Total doses of 19,000 mg. of teropterin in five months, and 12,740 mg. of diopterin in six weeks, were given without evidence of toxicity. In general, adult patients appeared to improve in energy, appetite, and sense of well being. They became less apprehensive and irritable, and in some findings are quite similar to those of the initial report. The general attitude at this time, however, is that there is no rationale for the use of folic acid conjugates in the treatment of malignant disease, since the drugs are broken down in the body to folic acid, and there is no evidence that malignant disease results from a deficiency of this substance (5). Because of the relief of pain and subjective improvement, the drug has been suggested as a possible substitute for narcotics.

FOLIC ACID ANTAGONISTS

Folic acid antagonists as a form of therapy have been developed chiefly as a result

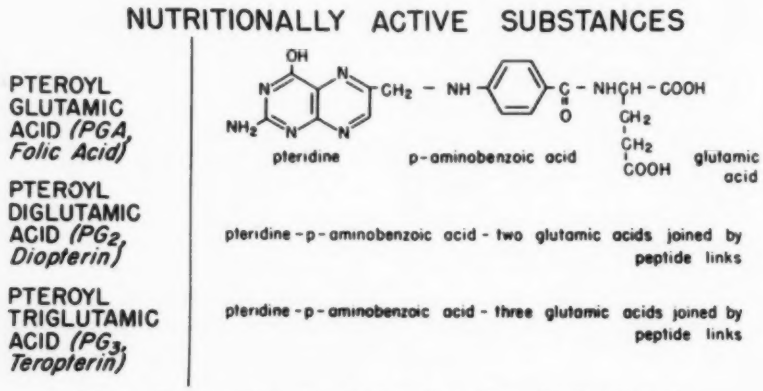
NUTRITIONALLY ACTIVE SUBSTANCES
PTEROYL GLUTAMIC ACID (PGA, Folic Acid)
PTEROYL DIGLUTAMIC ACID (PG2, Diopterin)
PTEROYL TRIGLUTAMIC ACID (PG3, Teropterin)
pteridine
p-aminobenzoic acid
glutamic acid
pteridine - p-aminobenzoic acid - two glutamic acids joined by peptide links
pteridine - p-aminobenzoic acid - three glutamic acids joined by peptide links

Fig. 1. Structural formulae of folic acid and its conjugates (Farber).

cases a distinct decrease in pain was suggested both by subjective reports and the smaller amounts of narcotics and analgesics required for comfort. Temporary changes in the size and number of lesions, of pulmonary metastases, and temporary depression of high phosphatase levels when bone metastases were present, suggested a distinct effect of the drug on the neoplastic processes.

The authors felt that, since the drugs were relatively non-toxic, further clinical trial was not only justified but imperative. Other reports of the use of these derivatives of folic acid are beginning to appear, and though there is no conclusive evidence that the course of the neoplastic diseases studied have been significantly altered, the of the observation by Farber (3) of changes in the marrow and viscera of children with acute leukemia treated by the injection of folic acid conjugates. Postmortem studies of leukemic infiltrates in patients receiving folic acid conjugates were regarded as evidence of an acceleration of the leukemic process to a degree not encountered in children not so treated.

Folic acid antagonists are substances which neutralize the effect of folic acid upon the growth of micro-organisms without chemical combination of the two substances. The "antagonism" is biologic, not chemical as in neutralization of an acid by a base. In the presence of marginal levels of folic acid, bacterial growth is inhibited by the antagonists; reversal

of inhibition occurs when the concentration of folic acid is increased (4).

Folic acid antagonists are perhaps better understood in the relationship of their chemical structure to the structure of folic acid and the folic acid conjugates, (Fig. 2). The main structural skeleton of folic acid is maintained, but minor alterations are made either at the glutamic acid end by substitution of other acids or in the cyclic compounds by the substitution of radicals attached to the rings. The initial drug used by Farber was pteroyl-aspartic acid. This was given to a four-year-old girl with acute leukemia without obvious clinical effect, but at postmortem the bone marrow was markedly hypoplastic and suggested an effect on the leukemic process. The next agent used following this encouraging observation was aminopterin, and to date this has been the one most widely employed.

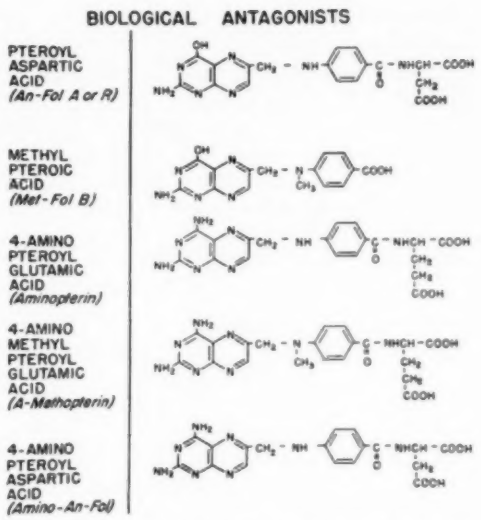
BIOLOGICAL ANTAGONISTS
PTEROYL ASPARTIC ACID (An-Fol A or R)
METHYL PTEROIC ACID (Met-Fol B)
4-AMINO PTEROYL GLUTAMIC ACID (Aminopterin)
4-AMINO METHYL PTEROYL GLUTAMIC ACID (A-Methopterin)
4-AMINO PTEROYL ASPARTIC ACID (Amino-An-Fol)

Fig. 2. Structural formulae of biological antagonists of folic acid (Farber).

Farber's initial report on aminopterin appeared in June 1948 (3). Sixteen children with acute leukemia were treated. Ten showed clinical, hematologic, and pathological evidence of improvement of at least three months duration at the time of the report. Rapid disappearance of immature cells in the peripheral blood took place after the institution of therapy. This was associated with reduction in the size of the spleen and of the liver and lymph nodes, when those organs were enlarged. Under treatment with aminopterin, the white blood cell count tended to return to normal levels. This occurred in patients in whom the count was initially high and also those in whom there was marked leukopenia at the onset of therapy. The percentage of immature cells and the blast forms decreased markedly, and in some cases abnormal cells disappeared from the peripheral blood. The relative percentages of mature leukocytes tended to approach normal values in the peripheral blood. Hemoglobin, red cell counts, and platelet counts also approached the normal. In the bone marrow, changes took place of a degree that varied from a decrease in number to a complete disappearance of the leukemic cells and from hypoplasia to an almost normal pattern.

A fairly characteristic course when aminopterin is effective is shown in Figure 3. This patient was treated by Dr. George Guest for ten months; the first four months of treatment are charted. Blast forms disappeared rapidly, the hematologic picture returned to normal, and the child appeared clinically well. Ultimately, he became refractory to treatment and died.

Dameshek, in a preliminary report (1), indicated essentially similar results in treatment of leukemic adults. Remissions were induced in approximately a third of the cases of acute and subacute leukemia.

Toxic effects of aminopterin are prominent and at times more distressing than the manifestations of the primary disease. These include stomatitis with ulceration of the mouth, diarrhea, and severe leukopenia. Often, when an effect has been obtained, and toxic effects supervene, discontinuance of the drug results in rapid resolution of the toxic manifestations, but persistence of the aminopterin-induced remission. In some series, aminopterin has appeared to be ineffective. An over-all picture, however, would suggest that am-

inopterin does have a decided effect on leukemia, as described above, but that the remissions are of only a temporary nature. No cure has been effected, although life has been distinctly prolonged. Details of the administration of the drug are included in several published reports (1, 3, 5, 7). Hodgkin's disease, lymphosarcoma, and neuroblastoma have shown temporary remissions following aminopterin therapy, but studies are still in progress and details are not available.

The initially encouraging results with aminopterin led to further syntheses in an effort to increase the therapeutic or carcinolytic properties and to decrease the toxic side reactions. A-Methopterin and amino-An-Fol (Fig. 2) were found to have the desired features (4). While these drugs are less toxic than aminopterin, the same toxic changes may be produced when appropriate doses are employed. Remissions in the course of acute leukemia likewise can be produced by these drugs. The dosage

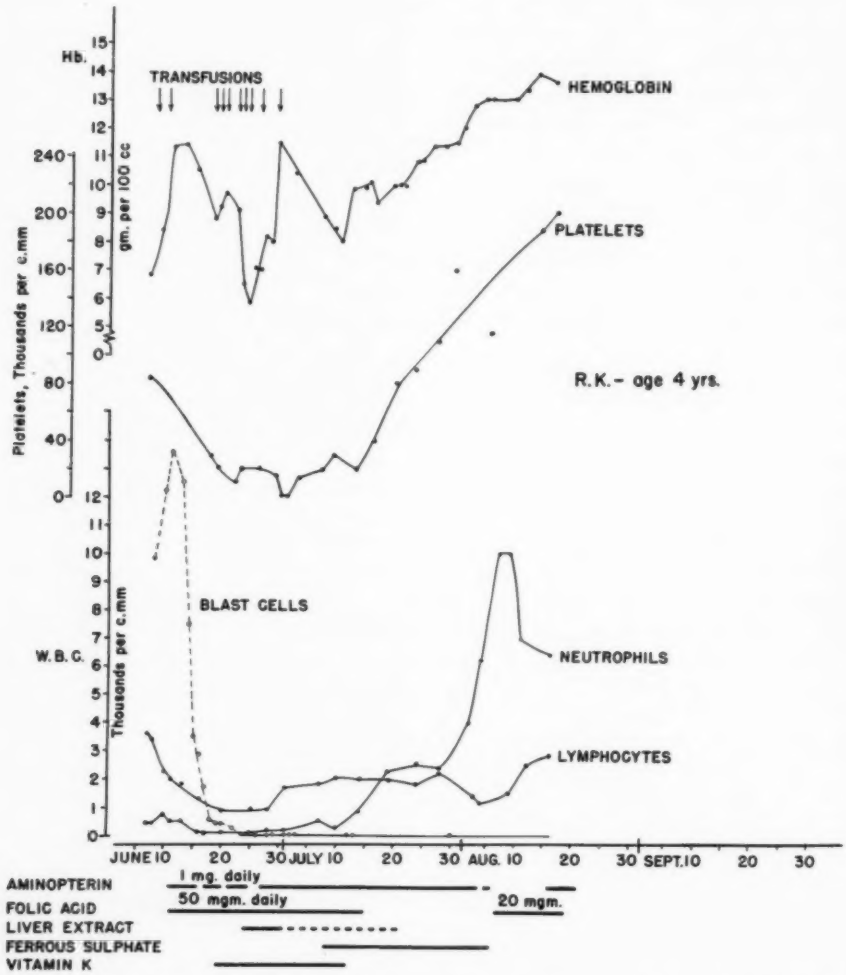

Fig. 3. R. K., age 4 years. Hematologic observations during treatment of acute leukemia with aminopterin. (Courtesy of Dr. George Guest.)

varies from three to fifty times the dosage of aminopterin.

A recent report (4) of results in a group of approximately 60 children with acute leukemia treated for three weeks or longer with folic acid antagonists can be summarized as follows: Somewhat more than 50 per cent showed improvement clinically and hematologically, of an important degree, attributable to the action of these compounds. Prolongation of life in a disease which began clinically as acute leukemia has lasted as long as twenty-one months. The average survival time in a group of cases studied at Children's Hospital, Cincinnati, is ten months, contrasted with an average survival time of five and one-half months observed in a large series prior to the use of these agents (9). Spontaneous remissions occurred in 10 per cent of 300 untreated children with leukemia according to Farber.

Because of the many variables in the localization of leukemic proliferation and their effect upon survival, divergent reports of small groups of cases are to be expected. As yet, a complete summary of a large number of treated patients from different centers has not become available. However, close contact with the drug in small series does leave one with the feeling that, although to date the results have been disappointing from the point of view of saving of life, the distinct increase in the survival period is very encouraging so far as the general principles involved in the exploitation of these compounds are concerned. The possibility of a combination of folic acid antagonist therapy with other types of treatment is still to be explored.

ROENTGEN CHANGES OBSERVED IN CHILDREN IN THE COURSE OF TREATMENT OF ACUTE LEUKEMIA WITH AMINOPTERIN

The occurrence of roentgenographically demonstrable lesions in the bones of children with leukemia is well known. Generally, four types of lesions have been recognized: transverse bands of increased density at the ends of the shafts of the long bones; focal and disseminated osteolysis; focal and disseminated osteosclerosis; subperiosteal new bone formation. The availability of a small group of leukemic children under treatment with aminopterin[2] afforded an opportunity for roentgen study of the effect of this drug on the development of these lesions. Since most of the lesions are related to focal accumulation of leukemic cells, and since aminopterin has been shown to exert an influence upon the proliferation of such cells, a demonstrable effect was a reasonable expectation. Eight children were studied serially. Films were taken at approximately monthly intervals over periods of two to fifteen months.

Skeletal lesions were observed initially in 7 of the 8 children. These lesions were primarily transverse bands of diminished density at the ends of the shafts of the long bones; in all cases, the lesions regressed during periods of clinical and hematologic remission. Generally, during relapse, recurrence of the lesions was not observed. However, as the children approached their terminal episodes and appeared refractory to aminopterin treatment, transverse lines reappeared, and destructive and productive lesions were noted. The disappearance of a true destructive lesion has been observed by Dr. Robert Heinle, at the Babies and Children's Hospital of Cleveland (Fig. 4). One milligram of aminopterin was given daily for two weeks, and thereafter twice weekly. The destructive lesion rapidly filled in and was completely remineralized in three months.

In serial studies of leukemic children, progression of skeletal lesions has been the rule. The failure of destructive or productive lesions to develop has been a striking finding during the course of treatment in all cases.

A totally unexpected and arresting phenomenon was the occurrence of heavy transverse bands of increased density at the ends of the shafts of the long bones. These heavy bands are exaggerations of the nor-

[2] The patients were all treated at the Children's Hospital, Cincinnati, under the direction of Dr. George Guest.

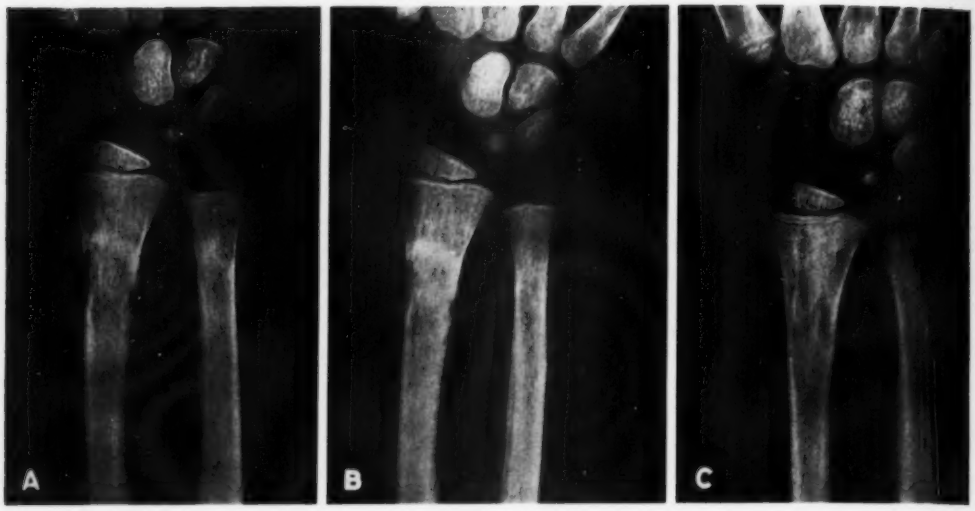

Fig. 4. R. S., age 4 years. Resolution of osteolytic leukemic lesions in acute leukemia during treatment with aminopterin. A. 5/28/48, at start of treatment; B. 6/3/48; C. 8/27/48. (Courtesy of Dr. Robert Heinle.)

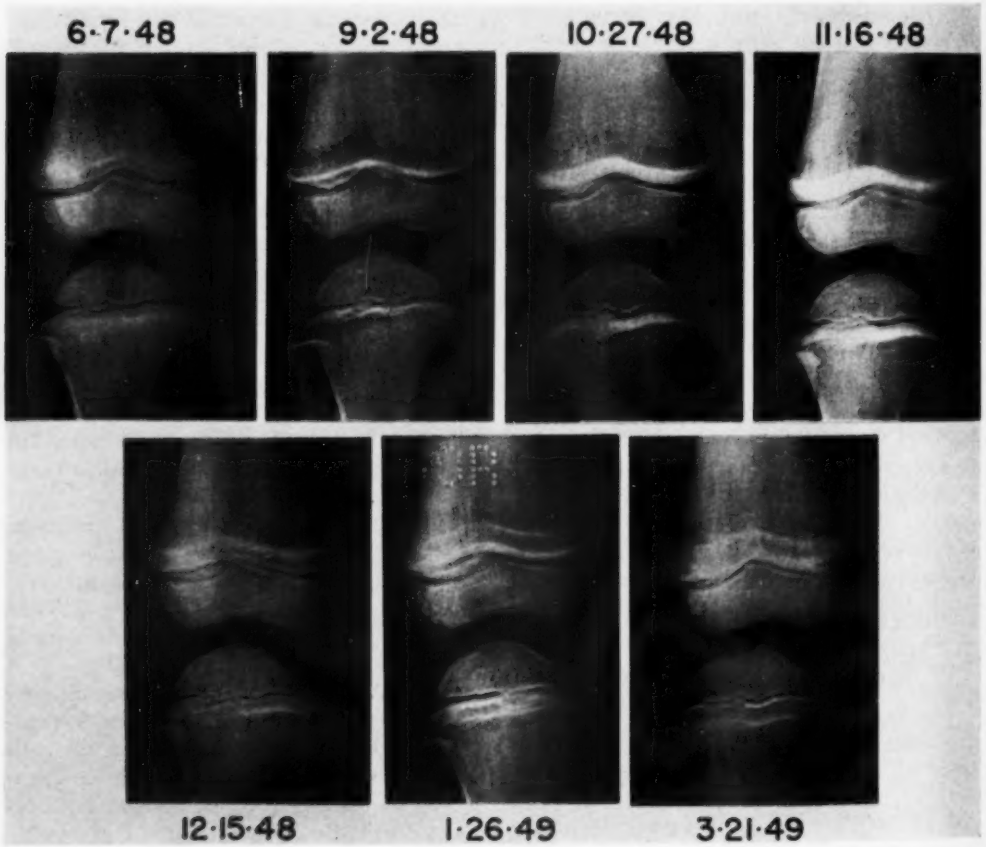

Fig. 5. R. K., age 4 years. Serial roentgenograms obtained during treatment of acute leukemia with aminopterin. Treatment started 6/11/48. See also Fig. 3.

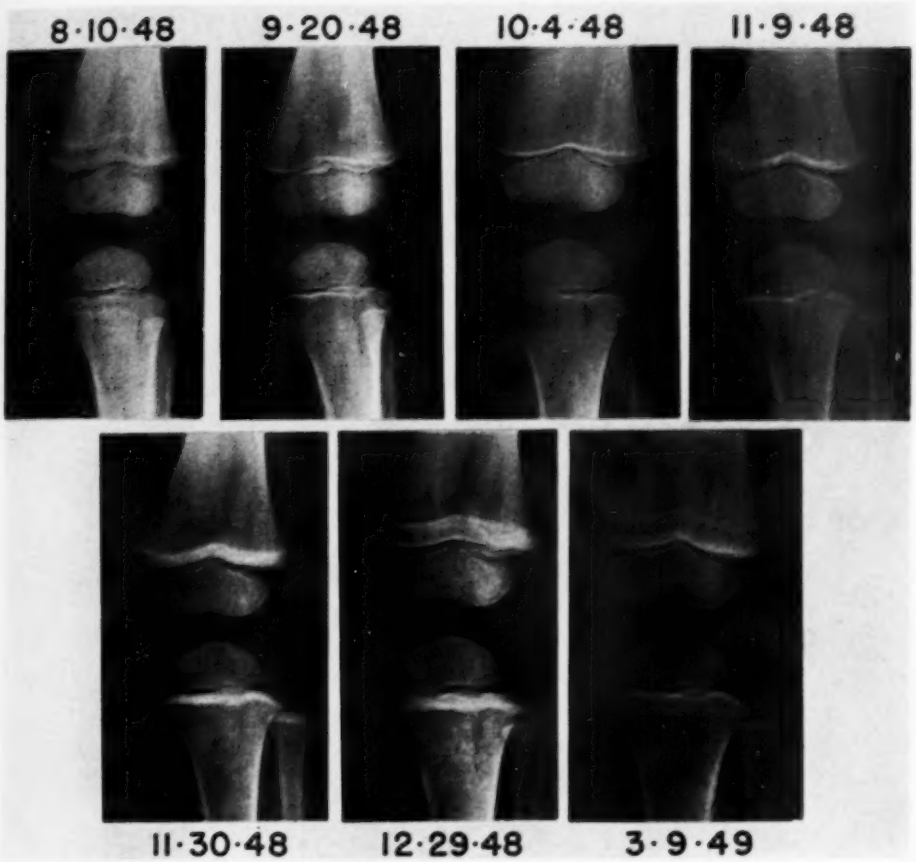

Fig. 6. D. P., age 1½ years. Serial roentgenograms made during treatment of acute leukemia with aminopterin. Note disappearance of transverse band of diminished density at end of shaft of femur as treatment continues. Treatment started 8/18/48.

mal calcified cartilaginous plate which indicates the boundary between shaft and epiphysis in normal growing bones. The observations in the following selected cases are characteristic of those in the group as a whole. In all the patients, the findings in the region of the knee were similar to those elsewhere in the body; they are more easily detected here because the mass of bone is greater and casts a denser shadow.

The findings in the roentgenograms of patient R. K. (Fig. 3) first directed our attention to a peculiar response of growing bone to the administration of aminopterin (Fig. 5). The initial examination of this child with classical leukemia demonstrated the leukemic lesions at the ends of the shafts of the tibia, fibula, and femur. The calcified cartilaginous plate was in no way unusual. Aminopterin treatment was begun June 11, 1948, and was continued irregularly for ten months, when death ensued. The dose varied from 2 mg. a week to 2 mg. a day, and there were several relatively short periods without treatment and several periods of remission and relapse (Fig. 3). Three months after the institution of treatment very little change was observed, although in retrospect faint changes can be detected in the epiphyseal plates in the direction of thickening and increased density. The unexpected finding of the heavy transverse band appeared in the film taken Oct. 27. Succeeding examinations on the

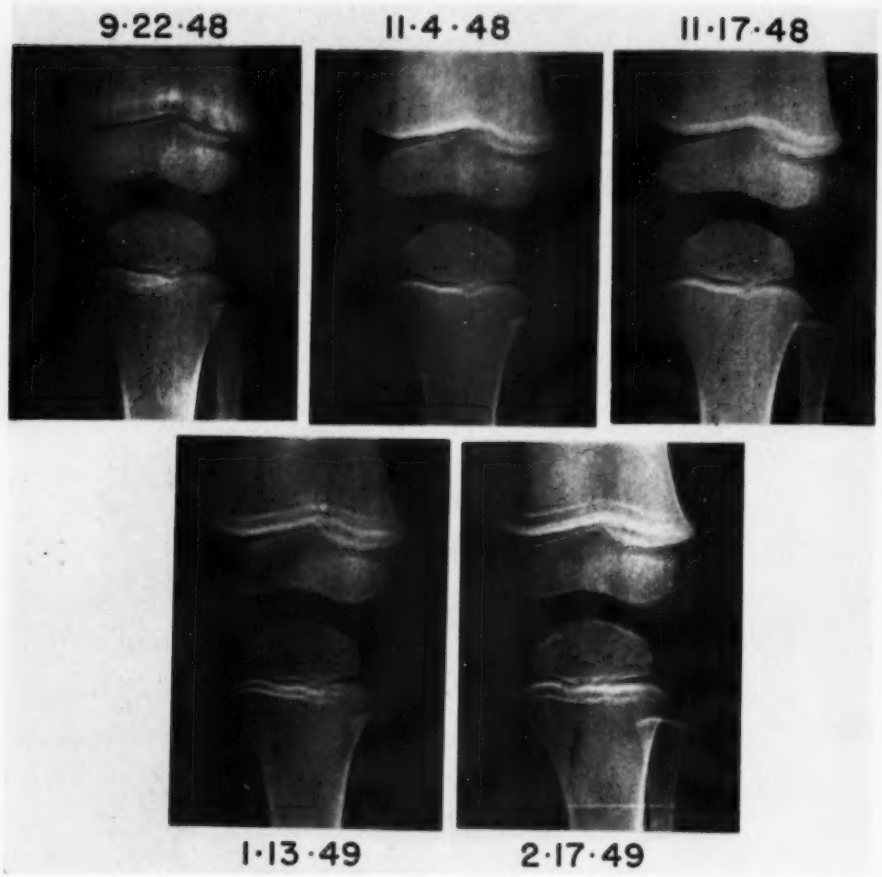

Fig. 7. J. A. V., age 2½ years. Serial roentgenograms made during treatment of acute leukemia with aminopterin. Treatment started 9/19/48.

dates indicated demonstrated changes which have occurred with striking frequency and similarity in all other patients studied. The transverse band of increased density gradually widens, but in widening tends to lose some of its density. The loss of density appears to occur in the region between the epiphyseal and the diaphyseal faces of the band. Gradually, two parallel lines are formed: one deep in the shaft, the other at the epiphyseal plate. The line in the shaft becomes more deeply buried as longitudinal growth of the bone carries the epiphyseal plate away from the region, and the epiphyseal plate again widens and undergoes the same cycle of changes. During this period of observation, no new lesions develop, and the original transverse band of diminished density tends to fade out as the bone at its site becomes remineralized.

Similar changes are present in the second case (Fig. 6), in a child of one and one-half years, with clinical onset dating to approximately July 1, 1948. Treatment was begun Aug. 18 and continued for exactly one year, when the patient died. Serial studies on other children demonstrate essentially identical findings (Fig. 7).

The appearance of transverse bands of increased density at the ends of the shafts of the long bones has not been described previously in leukemia. Review of films of children with the disease prior to the

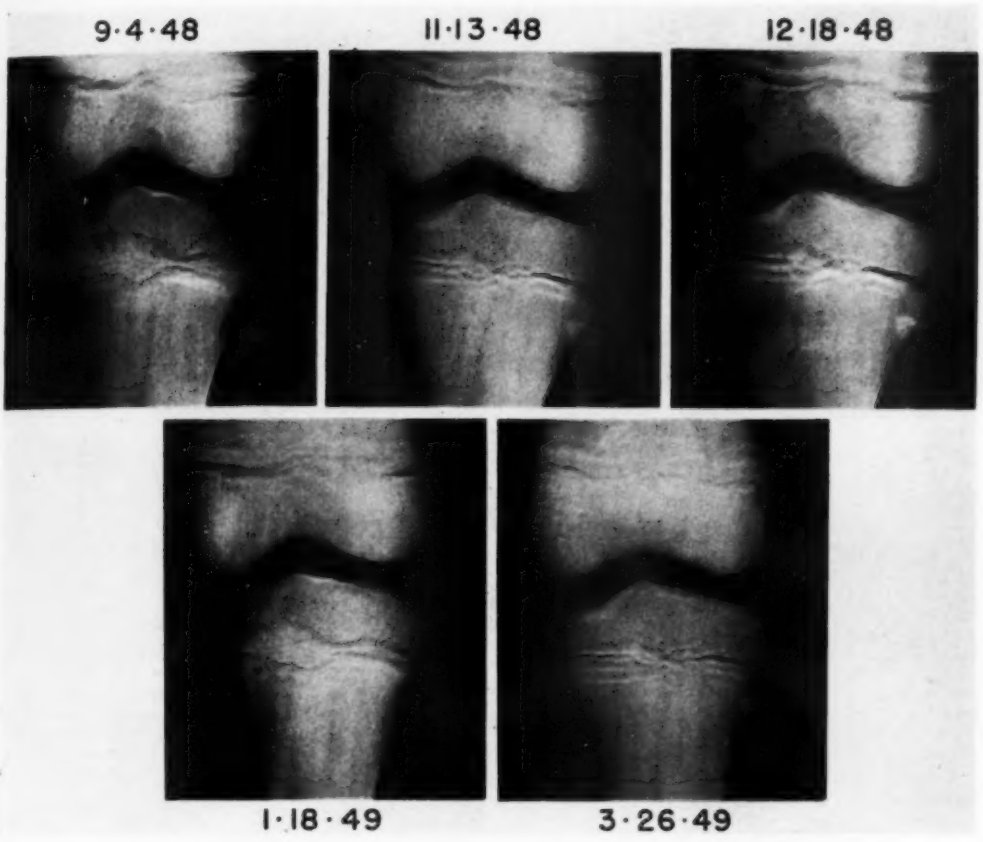

Fig. 8. L. M., age 8½ years. Serial roentgenograms made during treatment of acute leukemia with aminopterin. Spontaneous generation of transverse line prior to treatment.

advent of aminopterin therapy indicates that minor changes in this direction have been observed from time to time, but in no instance were the changes so marked as in these patients. One patient in the present series, however, did demonstrate transverse bands of increased density prior to the treatment with aminopterin. His serial films (Fig. 8) indicate that the spontaneously developed transverse band became buried in the shaft as a progressive increase in thickness in the epiphyseal plate took place, so that approximately two months after treatment was started, the epiphyseal plate had become wider than the fading internal line. From this point on, the serial changes are similar to those noted in other patients. Preliminary histologic study of bone from patients who have died during the course of observation demonstrates an increase in the number and thickness of trabeculae in the region of the transverse line and a persistence of a homogeneous gray-blue-staining material as a central core beneath the newly formed bone (Figs. 9–11). The relationship of this material to calcified cartilage is not entirely clear.

The roentgen observations provide presumptive evidence of the restrictive effect of aminopterin upon the proliferation of leukemic cells. Skeletal lesions usually related to focal accumulation of leukemic cells disappear during the administration of the compound, and new lesions develop late, if at all.

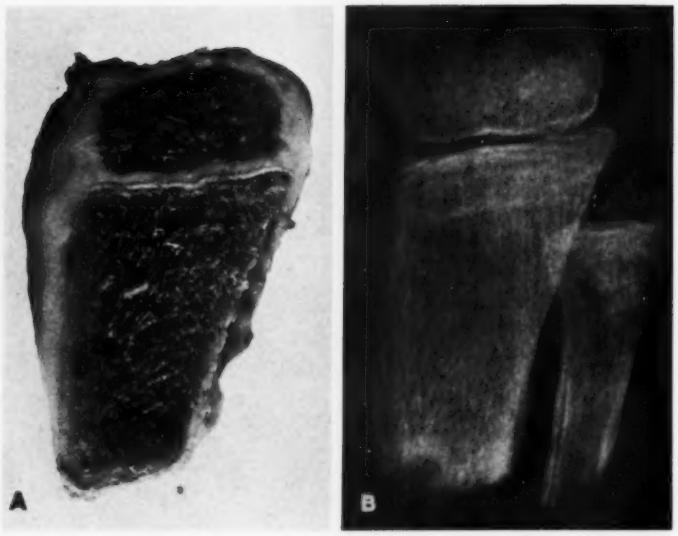

Fig. 9. R. K., age 4 years. A. Sagittal section through proximal end of tibia at necropsy, demonstrating dense bone structure under epiphyseal plate and residual transverse line formation deeper in the shaft. B. Roentgenogram of specimen in A.

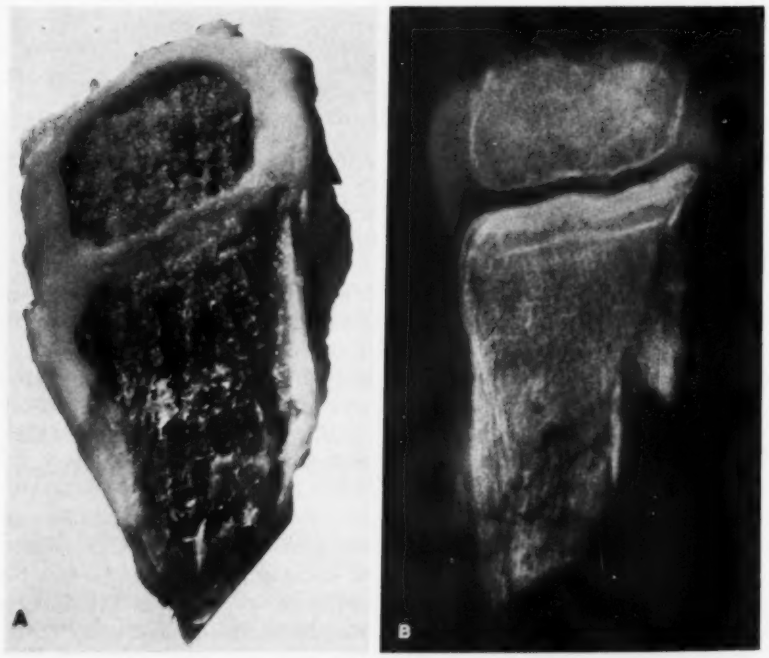

Fig. 10. J. A. V., age $2^1/_4$ years. A. Sagittal section through proximal end of tibia, demonstrating dense bone structure under epiphyseal plate and residual transverse line deeper in the shaft. B. Roentgenogram of specimen in A.

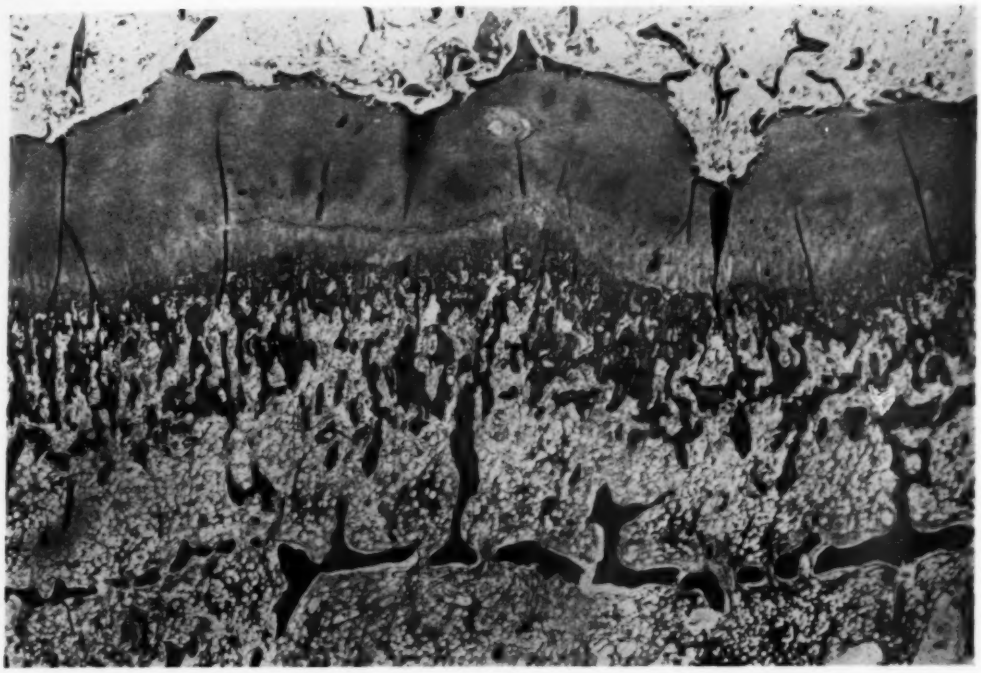

Fig. 11. Microscopic section through midportion of epiphyseal plate and subjacent transverse band and line formation from specimen shown in Fig. 10. The band shadow is produced by a transverse zone made up of many small trabeculae. The line shadow is produced by relatively thick, transversely disposed trabeculae. The lighter staining central cores of the small trabeculae stain gray-blue and resemble calcified cartilage.

The pathogenesis of the heavy transverse bands and lines remains to be clarified. The bands are identical roentgenographically with those seen in bones of growing children after exposure to heavy metals. In none of our 8 cases is there reason to suspect exposure to lead, bismuth, or phosphorus, which are the usual agents involved. The bands are heavier than those seen in normal children; they have been observed before in children with leukemia only rarely. It does not appear likely that they are the result of the disease alone in children kept alive by aminopterin, as the average survival time in leukemia is longer than the time required for development of the bands.

It is probable that the serial films indicate the sequence of events in the formation of transverse lines from whatever cause. An arrest of longitudinal growth need not be postulated to explain their development. The evidence that transverse bands and lines of increased density result only from retardation of longitudinal bone growth is far from conclusive. In one of our patients, measurements were made from the proximal end of the shaft of the radius, where growth is slow, to the distal end of the shaft, where growth is rapid (Fig. 12). Physical factors were kept constant for the several examinations. Prior to the administration of aminopterin, the distal epiphyseal plate was a line so thin as to defy measurement within the limits of the technic used. Therefore, the length of the bone corresponded to the length from the proximal end of the shaft to the internal face of the distal epiphyseal line. One month after institution of treatment, the heavy band was observed to appear. In this interval, the over-all length of the bone had increased 2 mm., and the distance from the proximal end of the shaft to the internal face of the epiphyseal line had increased 1 mm. Two

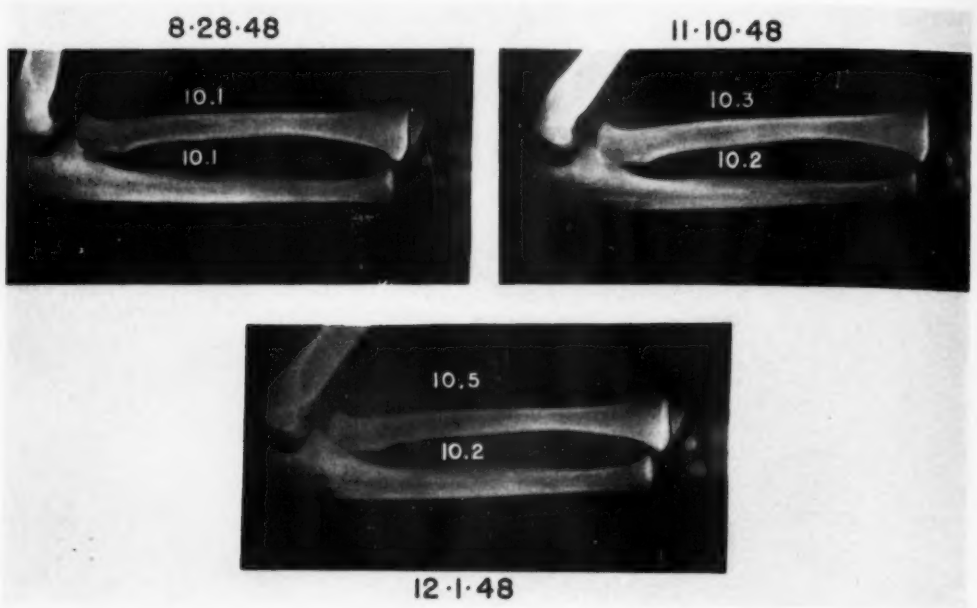

Fig. 12. B. G., age 2 years, 10 months. Transverse band formation during treatment of acute leukemia with aminopterin. The figure above the radius is the total length of the shaft in centimeters. The figure below the radius is the distance from the proximal end of the shaft to the diaphyseal border of the transverse band.

months later, the over-all length of the bone was 4 mm. greater than at the initial observation, but the distance from the proximal end of the shaft to the internal face of the wide band distally remained the same as at the previous examination. The last measurement remains unchanged because there is no interstitial growth of bone. An increase of 4 mm. in length in the course of three months in association with the development of a transverse line measuring 3 mm. in depth makes the retardation of longitudinal growth as the cause for the transverse band a very unlikely possibility. Heavy metals, severe illness, and factors yet unknown have an impact upon the growing skeleton which is manifested in transverse line formation. The observations suggest that aminopterin, a drug with potent biologic effects on several body systems, also affects endochondral bone formation to produce the alteration in architecture responsible for the roentgen shadows.

The continued study of folic acid antagonists in the treatment of malignant disease may find an additional form of control available in roentgen examination of the various structures. We have not yet had the opportunity to study the effect of aminopterin and allied substances on mediastinal lymph nodes or tumors elsewhere accessible to roentgen identification. Observations of this type, however, will undoubtedly be forthcoming as the studies progress. Careful observation may determine the presence of unexpected side-effects which may have value not only in treatment of disease but in investigation of physiologic processes such as the nature of longitudinal growth of bone.

SUMMARY

Several investigators have found that folic acid, a substance necessary for the growth of certain micro-organisms, when combined chemically with excess glutamic acid, has a deterrent effect upon the growth of certain experimental mouse neoplasms. In clinical trials, transient subjective and

objective improvements were observed. An acceleration of the malignant proliferation was observed when these drugs were used in the treatment of leukemia. Biologic antagonists to folic acid were therefore studied, and were found to produce remissions of leukemia in approximately 30 to 50 per cent of the patients treated. Current reports of the use of aminopterin, a potent folic acid antagonist, are reviewed.

Roentgen observations of skeletal lesions were made in a small group of children with leukemia, treated with aminopterin. Lesions initially present regressed during the course of treatment, and new lesions appeared only terminally. An incidental finding of transverse bands of heavy density at the ends of the shafts of the long bones is described, and their relationship to transverse lines in non-leukemic children is discussed.

Folic acid antagonists in the treatment of leukemia will have to be studied further, particularly in combination with other forms of therapy, before their place in practical therapeutics can be assessed. Observations of side-reactions may establish their value as experimental tools even if they are discarded for therapeutic use.

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SUMARIO

Tratamiento de la Leucemia y Trastornos Afines con Antagonistas del Acido Fólico. El Efecto de la Aminopterina sobre las Lesiones Esqueléticas

Varios investigadores han descubierto que el ácido fólico, sustancia necesaria para el desarrollo de ciertos microbios, cuando se combina químicamente con un exceso de ácido glutámico, ejerce efecto entorpecedor sobre el desarrollo de ciertas neoplasias experimentales del ratón. En las pruebas clínicas, observáronse pasajeras mejorías subjetivas y objetivas. Notóse aceleración de la proliferación maligna al usar dichas drogas en el tratamiento de la leucemia. Visto esto, estudiáronse los antagonistas biológicos del ácido fólico, descubriéndose que producían remisiones de la leucemia en 30 a 50 por ciento aproximadamente de los enfermos tratados. Repásanse aquí los informes corrientes acerca del empleo de la aminopterina, potente antagonista del ácido fólico.

En un grupillo de niños leucémicos, tratados con aminopterina, hiciéronse observaciones roentgenológicas de las lesiones del esqueleto. Las presentes al principio retrocedieron durante el tratamiento, y no se presentaron otras nuevas sino terminalmente. Un hallazgo fortuito fué la aparición de franjas transversales de mucho espesor en los extremos de las diáfisis de los huesos largos. Esas gruesas franjas son exageraciones de la placa cartilaginosa calcificada normal que señala la separación

entre diáfisis y epífisis en los huesos de desarrollo normal, siendo idénticas roentgenológicamente a las observadas en los huesos de los niños en vías de crecimiento tras la exposición a metales pesados, como plomo, bismuto y fósforo, y la evolución de los acontecimientos parece ser idéntica.

Los antagonistas del ácido fólico en el tratamiento de la leucemia tendrán que ser estudiados más a fondo, en particular en combinación con otras formas de terapéutica, antes de poder justipreciar su puesto en la terapéutica práctica. Las observaciones de las reacciones subsidiarias pueden establecer su valor como instrumentos de experimentación aun siendo desechados para empleo terapéutico.

Roentgen Therapy in Neuroblastoma

A Review of Seventy-three Cases[1]

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IN THE NEUROBLASTOMAS of infancy and childhood the physician is dealing with a multipotential tumor which may be curable. The outcome will in part depend upon the localization of the primary lesion, the presence and distribution of metastases, and the selection of the type of therapy.

Neuroblastoma was first described by Virchow (1) in 1864 and classified as a glioma. The clinical picture was described by Pepper (2) in 1901 and Hutchison (3) in 1907, and their names have become associated with two clinical types based upon the distribution of the metastases, the adrenal hepatic distribution of the tumor being subsequently known as Pepper's type and the adrenal skeletal, specifically with skull metastases, as the Hutchison type. Studying the suprarenal tissues of embryos, Wright (4) in 1910 first recognized the similarity of the cells to those of these tumors and concluded that the origin must be from the sympathetic nervous system. Farber (5) in 1940 and Karsner (6) in 1942 finally dispelled the concept of the Pepper and Hutchison types of neuroblastoma, showing that the distribution of the metastases bears no relationship to the cytological character or the anatomical site of the primary growth.

In a recent (1942) review article, Rosendal (7) estimates the total cases of neuroblastoma reported in the literature to be approximately three hundred. Little has been written, however, on the therapy of this tumor. Farber (5), in 1940, was the first to report that "permanent cures" could occur in neuroblastoma patients. He pointed out, in a study of 40 cases, that neuroblastoma may undergo spontaneous hemorrhage and necrosis, disappearing without treatment, and that the tumor may also undergo spontaneous maturation, becoming a benign ganglioneuroma. Wyatt and Farber (8) in 1941 amplified this study, recommending radiation therapy "in every case after the diagnosis is established." The basis for this recommendation was the fact that of 10 children (of a series of 40) with neuroblastoma who received x-ray therapy as part or all of their treatment, 5 survived two to five years, while among the 30 receiving all other forms of therapy, but no x-ray, the number of two- to five-year survivals was also 5. Although statistically not significant, these figures are suggestive that x-ray therapy is beneficial. The medical literature fails to yield any more decisive information on the value of irradiation in neuroblastoma.

SCOPE OF REVIEW

At The Children's Medical Center of Boston, 143 neuroblastomas are recorded to 1949. The patients were seen under a variety of circumstances and were handled in many different ways. Six cases lack absolute microscopic confirmation on review of material now available. Twenty lack sufficient clinical data for tabulation (some sent in for postmortem study only, some with death shortly after admission without postmortem examination, etc.). Twenty-three cases were primary in, or showed extensive involvement of, the central nervous system. Twenty-one patients received either radioactive drugs or nitrogen mustard or anti-folic-acid derivatives as part of their therapy. These 70 cases will not be reported in this review, as it is our purpose to present pri-

[1] Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

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marily those cases in which it is hoped that roentgen irradiation effects can be evaluated without the introduction of such additional factors as radioactive compounds or the so-called chemical antagonists.[3]

For the 73 patients considered, complete clinical histories and microscopic confirmation of the diagnosis are available. Patients having received no specific therapy, or surgical therapy only, are briefly reviewed as general background material. It is not valid to use the percentage survival figures, to be presented, for comparative evaluation of the relative effectiveness of surgical, surgical and x-ray, and x-ray therapy, as a selective factor was of necessity introduced in choosing the type of treatment. Localized tumors were usually treated only by surgery. Patients thought to be clinically unsuitable for surgery, or found to be so at operation, usually received x-ray therapy.

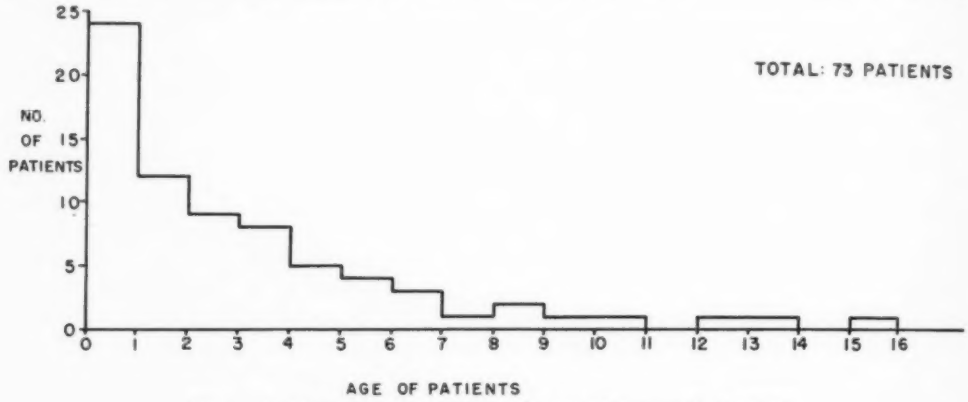

Fig. 1. Age distribution of patients with neuroblastoma in this series.

TABULATION OF DATA

Of the series of 73 patients, 51.4 per cent are males and 48.6 per cent females. The age distribution is charted by histogram in Figure 1: 32.4 per cent of the cases occurred within the first year of life, 80 per cent within the first five years of life, with only 20 per cent occurring after the fifth year. Patients over fifteen years of age are rarely seen at this hospital. Neuroblastomas are rare in adults.

The location of the primary tumor in the 73 patients is shown in the last column of Table I. They occur most frequently in the upper abdomen, next most frequently in the pelvis. In 6 of the patients, or 8 per cent, the site remained unknown. Only 40 per cent of the series showed evidence of a localized primary tumor.

In 44, or 60 per cent, of our patients, the tumor had already metastasized at the time of diagnosis. The distribution of the metastases is shown in Table II. Skeletal metastases are by far the most common, although it should be noted that 8 patients had metastases limited to the liver, 4 to the mediastinum, 3 to the liver and mediastinum, and 1 to the liver and skin, without evidence of skeletal metastases.

Twenty-eight patients received no specific therapy. These are presented in the first column of Tables I and II. Eight of these patients were seen with a localized primary tumor and no evidence of metastases, as shown in Table II. In 2 of these the diagnosis was made incidentally at autopsy; 3 died with extensive local invasion of the abdominal viscera and/or lymph nodes within twelve months after diagnosis. One died with metastases ten years after diagnosis was established.

[3] A report on these and other therapeutic agents, and the pathologic responses of this tumor on a broader basis, is forthcoming as a result of work now in progress by Dr. Sidney Farber and associates, Department of Pathology, The Children's Medical Center.

TABLE I: RESULTS OF TREATMENT ACCORDING TO SITE OF TUMOR

Site of Primary Tumor	1 No Therapy		2 Surgery Only		3 Surgery and X-ray		4 X-ray Only		5 Totals	
	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years
Abdomen	23	1* (4%)	7	6 (85%)	9	5 (56%)	16	6 (37%)	55 (74%)	18 (33%)
Pelvis	1	1 (100%)	2	0	2	1 (50%)	1	0	6 (8%)	2 (33%)
Chest	2	1 (100%)	2	0	0	...	1	0	5 (7%)	1 (20%)
Neck	0	....	1	1 (100%)	0	...	0	...	1 (2%)	1 (100%)
Unknown	2	0	0	....	0	...	4	0	6 (8%)	0
Totals	28	3 (10%)	12	7 (54%)	11	6 (54%)	22	6 (27%)	73	22 (30%)

* This patient died ten years following diagnosis, with metastases.

TABLE II: RESULTS OF TREATMENT IN RELATION TO METASTASES

Presence and Distribution of Metastases	1 No Therapy		2 Surgery Only		3 Surgery and X-ray		4 X-ray Only		5 Totals	
	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years	No. of Patients	No. Surviving 3 Years
Metastases	20	0	1	1 (100%)	2	0	21	6 (28%)	44	7 (15%)
Skeleton only	11	0			2		8	0	21	0
Liver only	2	0					6	6 (100%)	8	6 (65%)
Mediastinum only	1	0	1	1			2	0	4	1 (25%)
Skeleton and mediastinum	1	0					2	0	3	0
Liver and mediastinum	3	0					0		3	0
Liver, skeleton, mediastinum	0						1	0	1	0
Liver and skeleton	1	0					1	0	2	0
Liver and skin	0						1	0	1	0
Skin, skeleton and mediastinum	1	0					0		1	0
No metastases	8	3 (37%)	11	6 (54%)	9	6 (66%)	1	0*	29	15 (52%)
TOTALS	28	3 (10%)	12	7 (58%)	11	6 (54%)	22	6 (27%)	73	22 (30%)

* Primary tumor in pelvis in 6-month-old infant who died in uremia one week after x-ray treatment and at autopsy was found to have bilateral ureteral obstruction and hydronephrosis. The primary tumor showed "extensive necrosis," presumably secondary to irradiation.

The remaining 2 patients are living and well, twelve and sixteen years after operative and histologic confirmation of the diagnosis. The 20 patients with metastases at the time of diagnosis all died within a year.

Surgical excision of the tumor only, without other specific therapy, was the form of treatment used in 12 patients. These are presented in the second column of Tables I and II. In 7 the primary tumor was localized in the abdomen, either in or closely approximate to the adrenal gland. Six of these patients, or 85 per cent, survived three or more years. Further analysis of the surgically treated cases

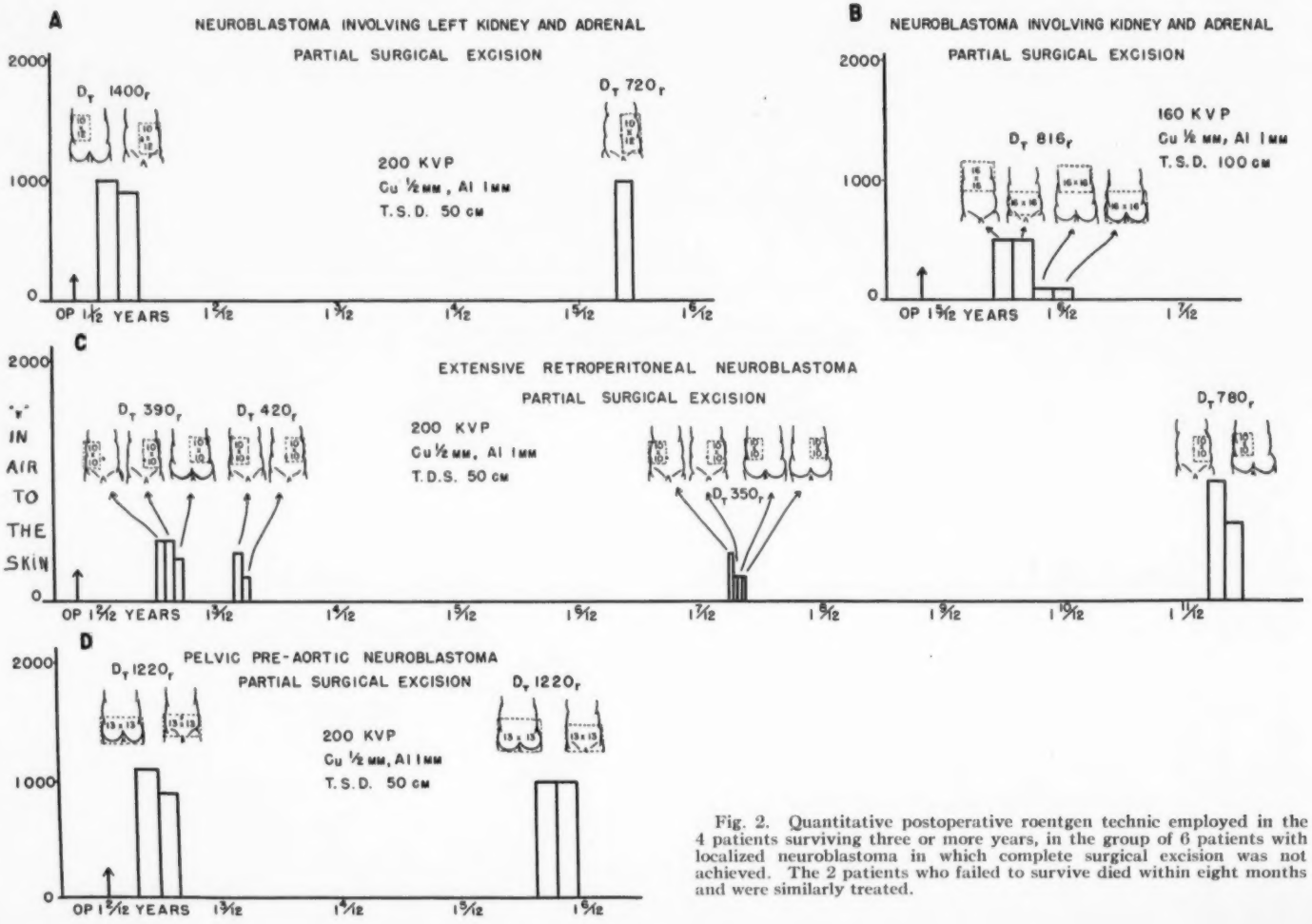

Fig. 2. Quantitative postoperative roentgen technic employed in the 4 patients surviving three or more years, in the group of 6 patients with localized neuroblastoma in which complete surgical excision was not achieved. The 2 patients who failed to survive died within eight months and were similarly treated.

will not be made here, but it should be pointed out that in the presence of a localized tumor without evidence of distant metastases at the time of operation, all patients who survived the first year have continued living and well, having been followed four to sixteen years. The only patient who died after the first year was a thirteen-year-old girl with involvement of the chest and abdomen, presumably by lymphatic spread, in whom complete surgical removal of the tumor was not possible and who received no postoperative x-ray therapy.

Roentgen therapy was administered to 11 patients following surgical treatment of the tumor. (No patients in this series received preoperative roentgen therapy.) These are presented in column 3 of Tables I and II. In 9 patients the tumor was in the upper abdomen, and in 2 it was in the pelvis. Two of the 11 patients presented evidence of skeletal metastases at onset of therapy; both died within eighteen months of treatment. The 9 remaining patients were considered to have localized tumors without evidence of metastases at time of operation. Six of these 9 survived three or more years, representing a three-year survival of 66 per cent. A detailed analysis of these 9 cases is made in an effort to evaluate the possible role of postoperative irradiation. In 3 of them the surgeon felt that a complete surgical excision of the tumor had been achieved. One of the patients, a one-day-old child, died ten days after operation, of causes other than neuroblastoma, while 2 survived three or more years. In 6 of the 9 patients with localized neuroblastoma, excision of the tumor was incomplete; tumor tissue is known to have been cut across and macroscopic tumor left behind. Of these 6 patients, 2 died within eight months, 1 of causes unknown and without postmortem studies, 1 of complications of x-ray therapy to be discussed later. Four patients with known residual tumor are, however, still living and well, having been followed three to nine years. Thus, in our patients with localized neuroblastoma, even though complete surgical excision was not achieved, we find a 66 per cent three-year survival if postoperative irradiation was given. Probably in no known malignant tumor does postoperative irradiation offer so promising a prognosis following incomplete surgical excision.

Twenty-two patients with neuroblastoma underwent biopsy only, followed by roentgen irradiation. The location of the primary tumor is shown in the fourth column of Table I. The number and distribution of metastases, with three-year survival percentage, are set forth in Table II. The only patient without evidence of metastases at the beginning of x-ray therapy was one with a pelvic tumor. This patient died in uremia of ureteral obstruction by the tumor within one week after treatment was begun—a potent argument for partial surgical excision when possible. Of the 21 patients with metastases receiving only x-ray therapy, 6 survived three to twelve and a half years and all remain living and well. All 6 of these patients had primary abdominal tumors with metastases limited to the liver. These were all confirmed by direct biopsy of a liver nodule prior to therapy. Of the remaining 15 patients with metastases (including 3 with liver metastases, but not limited to the liver), all died within the year after biopsy and initiation of therapy.

ROENTGEN THERAPY
TECHNIC AND DISCUSSION

The technic of roentgen therapy has varied widely over the years. For this reason a schematic, but quantitative method of presentation of individual cases is used in Figures 2–4. In these diagrams the abscissa represents time in years (each unit representing one month), the ordinate represents roentgens in air delivered to the skin, each column representing a separate port as shown by the figure above it. The width of the columns gives the duration of the course. In all cases single daily doses, using one port daily, were given, with alternation of ports daily.

The technic of irradiation used in the four surviving patients who received post-

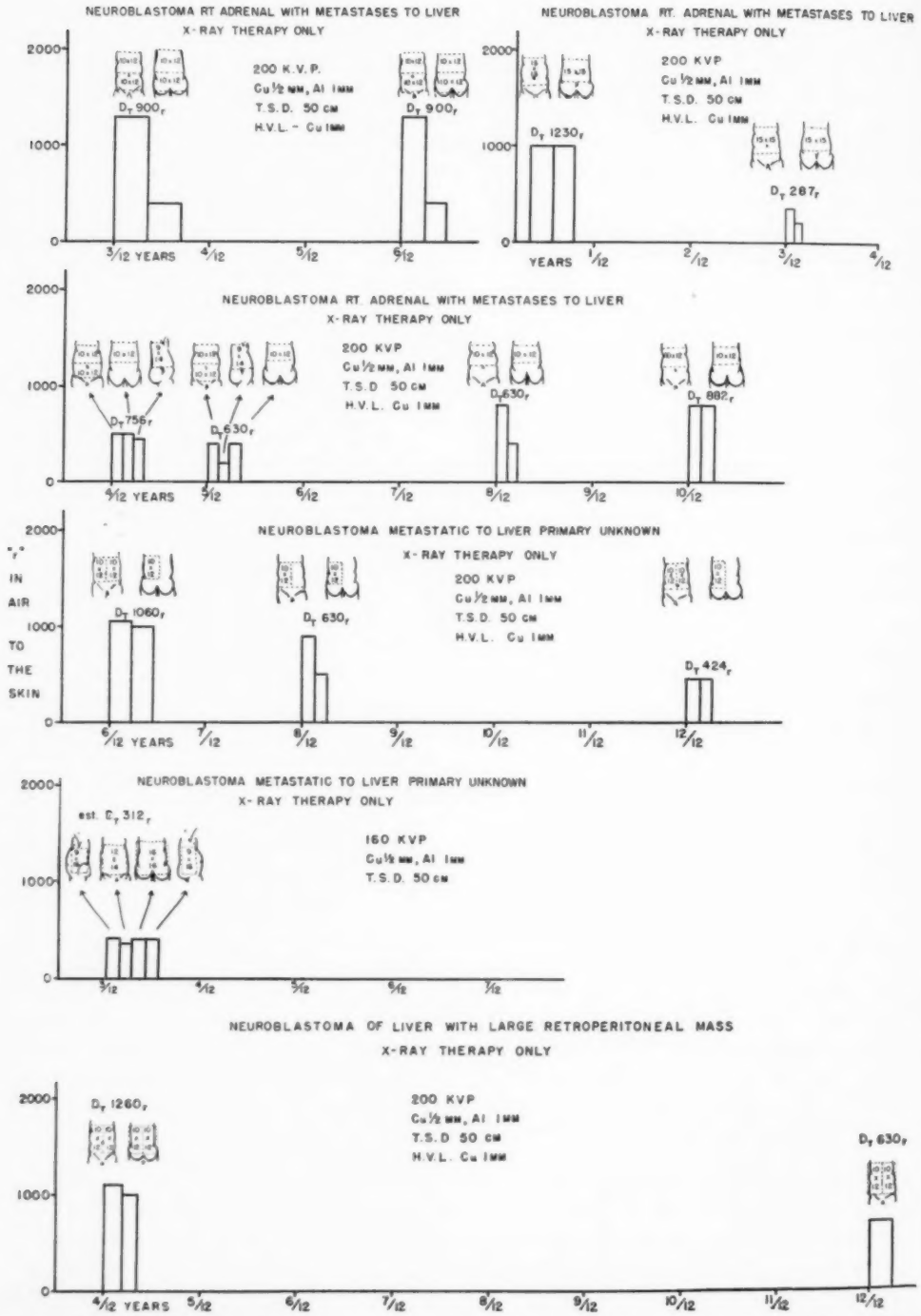

Fig. 3. Quantitative roentgen technic in the 6 cases of metastatic neuroblastoma limited to the liver. These patients are all living and well three or more years following treatment.

operative irradiation following incomplete excision of the tumor is shown in Figure 2. The patient with the longest survival is a child with a neuroblastoma involving the left kidney and adrenal in which a mass of tumor estimated at 50 per cent was left behind. She was operated upon at the age of one year and three months and is now living and well nine years later. Postoperative therapy was given as shown in Figure 2,B. The estimated tumor dose was 816 r in twenty-three days. One child operated upon at the age of a year and two months required extensive surgery, but tumor was probably left behind. He is living and well five years after surgery. Postoperative therapy was given as shown in Figure 2, C. The follow-up period for the other 2 with known tumor left postoperatively is three years and eight months in one and three years in the other, as shown in Figure 2, A and D.

The technic used in those patients who received irradiation only has also varied considerably. The specific procedure followed in the 6 patients with metastases limited to the liver, all of whom lived, is shown in Figure 3.

After reviewing the therapy of the patients who failed to recover, as well as of those who are apparently cured, we feel, on the basis of the information available, that one cannot be dogmatic about the technic of administration or optimum dosage. Certain empirical statements, however, may be made.

(1) On the premise that the tumor dose and time factor are the most important elements in the response of an individual tumor, it should be emphasized that complete regression of tumor with cures has been achieved with as small a tumor dose as 400 r in sixteen days. Viable tumor has been found postmortem at the site of the primary growth following a tumor dose of 600 r in ten days, repeated again one month later (total D_t 1,200 r). This is, of course, in part due to the characteristic "individual variation" of the neuroblastoma, morphologically, as shown by pathologists, as well as in its behavior in the few cases showing metamorphosis from the malignant to the non-malignant state (ganglioneuroma) even in the absence of therapy.

(2) It should be pointed out that almost all of our patients who survived without complications of treatment received initial tumor doses of 800 to 1,200 r in ten to fourteen days, usually followed by a second comparable series in three months.

(3) The practice of earlier therapists of initiating treatment with very small doses 50 to 75 r, with gradual increases, has not been followed in the past ten years. The fear that larger initial doses may initiate fatal hemorrhage has not proved to be well founded in our experience.

(4) It has been our practice, in recent years, to give postoperative irradiation as soon after surgery as possible and not wait until healing of the surgical incision is complete. Our patients are now commonly brought directly from the operating room to the x-ray therapy department and treatment is initiated on the day of operation. An initial dose of 200 r in air delivered to the skin is usually given through a port opposite the surgical incision, which is in the exit port. Dosages of this magnitude are repeated daily to one port, until the incision is healed. Thereafter the ports are alternated. It is believed that if good surgical closure and exact approximation of the layers is achieved, one need not fear complications of immediate postoperative x-ray therapy in children with air doses to the skin of 1,400 and 1,800 r in seven to ten days. Complete absence of wound breakdown in our series confirms this statement.

(5) The limiting dosage factor in the treatment of infants and small children is not the skin, but the response of the hematopoietic tissue. Vertebrae examined postmortem which were within the direct field of therapy showed evidence of bone marrow depression to the degree of complete hematopoietic stasis and fibrous replacement of marrow. This was true for calculated tumor dosages of as little as 600 r in ten days, repeated twice, one month apart. Marrow specimens distant from the field of irradiation showed evidence of

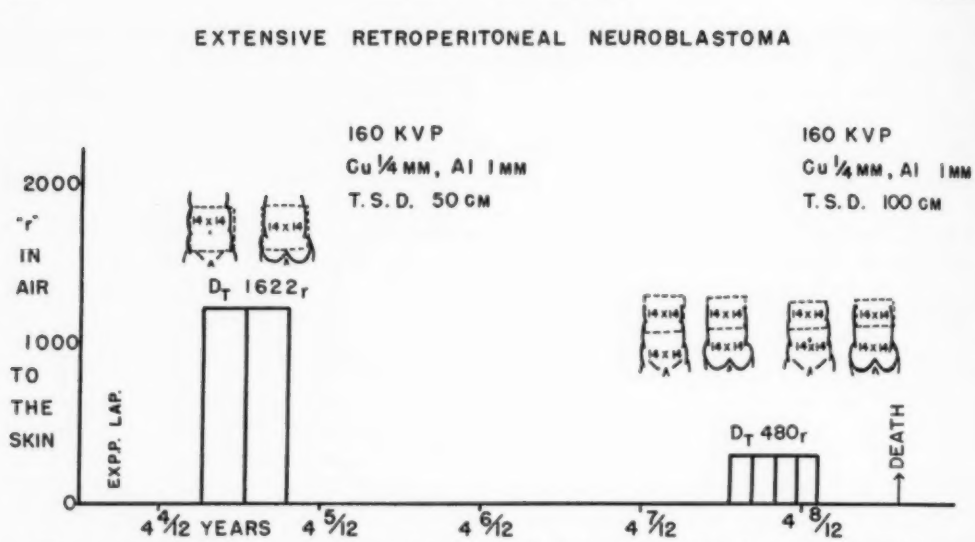

Fig. 4. Quantitative roentgen technic employed in a child with extensive abdominal retroperitoneal neuroblastoma who died with complete pancytopenia shortly after the second course of treatment. *Note:* Both the chest and abdomen were exposed to irradiation. At postmortem examination complete suppression of bone marrow activity was noted in ribs and vertebrae.

hyperplasia, presumably compensatory. It is axiomatic that the total amount of hematopoietic tissue irradiated and the dosage to which it is subjected are the decisive factors in determining the recovery of the infant or small child from radiation effect. One patient in this series died with clinical pancytopenia and complete bone marrow suppression confirmed at autopsy. Irradiation had been given to the entire thorax and abdomen as illustrated in Figure 4. A similar case, treated since January 1949, with death and pancytopenia, is not included in this series. Both of these patients received roentgen therapy to the chest and abdomen and thus had the major portion of their hematopoietic tissue exposed to deep irradiation. In the group of patients who survived, none had received irradiation to both chest and abdomen. Although statistically this is a small group, the experience would indicate that deep x-ray therapy directed to the mediastinum and abdomen in tissue dosages up to 600 r, if justifiable at all, should be undertaken with considerable reservation.

(6) Preoperative x-ray therapy has not been used in the patients in this series. Reduction in the size of the mass has not been considered a valid indication. The size of the tumor has not proved to be the limiting factor in surgical attack. The argument that reduction of incidence of metastases might be achieved by preoperative x-ray therapy is still a theoretical one to be evaluated in the light of the necessary delay in operation and the hyperemia produced by the irradiation. Our material sheds no light on this problem.

(7) Growth disturbances in the spine, though observed, have not proved to date to be a decisive factor in selecting x-ray therapy. Scoliosis and kyphosis have not been observed as complications.

SUMMARY

1. Seventy-three cases of neuroblastoma are reviewed, including 28 which received no therapy and 45 treated by surgery, surgery and postoperative x-ray therapy, or x-ray therapy only. Twenty-two patients, or 30 per cent, survived three or more years. Twenty of these are still alive and apparently cured, some having been followed twelve to sixteen years.

2. As in most cases of malignant growth, early detection and complete surgical excision of the local tumor offer the best prognosis; approximately 60 per cent three-year survival was achieved in our group.

3. If surgical excision of the primary tumor is incomplete and there are no metastases, postoperative irradiation still offers a good prognosis, with approximately 60 per cent three-year survivals.

4. The site of the primary lesion is probably of less importance than the presence and distribution of metastases. With skeletal metastases, death uniformly occurred within a year, irrespective of surgical or x-ray therapy. Involvement of both chest and abdomen, whether by direct extension or lymphatic spread, proved fatal in all patients. Primary neuroblastoma in the abdomen, with metastases to the liver, however, still offers an excellent prognosis if treated by irradiation. A 100 per cent three-year survival in this group of 6 patients is reported.

5. The technic of irradiation is presented.

6. The complications of irradiation in infancy and childhood are discussed. The limiting dosage factor is the volume of hematopoietic tissue exposed to irradiation, not the skin. In this series, a single fatality as a result of x-ray therapy was observed.

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SUMARIO

La Roentgenoterapia en el Neuroblastoma. Repaso de Setenta y Tres Casos

Este repaso de 73 casos de neuroblastoma comprende 28 que no recibieron tratamiento y 45 tratados con la cirugía, la cirugía y la roentgenoterapia postoperatoria o la roentgenoterapia sola. Veintidós enfermos, o sea 30 por ciento, sobrevivieron tres años o más. Veinte de éstos se hallan todavía vivos y aparentemente curados, habiendo sido algunos de ellos mantenidos en observación por espacio de doce a dieciséis anos.

Lo mismo que sucede en la mayor parte de los casos de tumor maligno, el descubrimiento temprano y completa excisión quirúrgica del tumor local ofrecen el mejor pronóstico: en el grupo comunicado ahora obtuviéronse así aproximadamente 60 por ciento de sobrevivencias de tres años.

Si la excisión quirúrgica del tumor primario es incompleta y no hay metástasis, la irradiación postoperatoria ofrece todavía un pronóstico bueno, con 60 por ciento aproximadamente de sobrevivencias de tres años.

El sitio de la lesión primaria reviste probablemente menos importancia que la presencia y distribución de metástasis. Si había metástasis esqueléticas, la muerte sobrevino inevitablemente en término de un año, a pesar del tratamiento con la cirugía o los rayos X. La invasión tanto del tórax como del abdomen, ya por difusión directa o propagación linfática, resultó siempre letal. Sin embargo, el neuroblastoma primario del abdomen, con metástasis hepáticas, ofrece todavía excelente pronóstico, si se le trata con la irradiación,

comunicándose aquí 100 por ciento de sobrevivencias de tres años en un grupo de 6 enfermos.

Descríbese la técnica de la irradiación. El tratamiento suele instituirse inmediatamente después de la operación, con una dosis inicial de 200 r al aire llevados a la piel a través de una puerta opuesta a la incisión quirúrgica. Dosis de esa magnitud se repiten diariamente a una puerta hasta que cicatriza la incisión, después de lo cual se alternan las puertas. Casi todos los enfermos que sobrevivieron sin complicaciones terapéuticas recibieron de 800 a 1,200 r en término de diez a catorce días, por lo general con otra serie de tratamiento comparable al cabo de tres meses.

Repásanse las complicaciones de la irradiación en la niñez. El factor que limita la dosis no es la piel, sino el volumen de tejido hematopoyético expuesto a la irradiación. En este estudio, no se observó más que una sola muerte a consecuencia de la roentgenoterapia.

Wilms' Tumor: Evaluation of Treatment Methods[1]

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THE TREATMENT of Wilms' tumor of the kidney has been a controversial subject for many years. There has been fairly unanimous agreement as to the necessity for surgical removal of the affected kidney if a cure is to be expected, although even this has been disputed by some authors (16). But the advisability of preoperative and postoperative irradiation has never been established from adequately controlled clinical studies. For this reason it was thought desirable to review the literature and analyze the reported cures in an attempt to evaluate irradiation before and after surgery as an adjunct in the treatment of this condition.

HISTORICAL

The first case report of an embryonal kidney tumor was that of Gairdner in 1828 (25). He called the lesion "fungus haematodes," and many other names have been used in describing it since that time. In the 121 years since Gairdner's original report, many hundreds of cases have been added to the literature. The name of Wilms was applied to the tumor following his classical monograph in 1899 (79). This designation has been in general use since that time. In more recent years, with the trend toward avoidance of proper names in connection with disease entities, the more descriptive terms of embryoma and adenomyosarcoma have been used. Birch-Hirschfeld introduced the term embryonal adenosarcoma in 1898 (6).

INCIDENCE

According to Campbell (12), Wilms' tumor comprises 20 per cent of all the malignant tumors in infancy and childhood. The disease is seen characteristically in the young, 75 per cent of the cases occurring before five years of age.

GROSS AND MICROSCOPIC APPEARANCES

Adequate descriptions of the gross and microscopic appearance have been published elsewhere and need not be repeated here. It is important, however, to emphasize the embryonal nature of the tumor because of the relationship to its radiosensitivity. All authors seem agreed as to the embryonic origin, although there is some disagreement as to the stage of development at which the tumor appears. Dean and Pack (19) explain this disagreement logically by the fact that in different cases the tumor arises at different stages in the development of the kidney and hence presents the varying histologic appearances which have led to the controversy. The different degrees of radiosensitivity of the tumor are dependent upon the proportion of embryonal sarcomatous cells to epithelial cells. The former are radiosensitive, the latter radioresistant. The marked reduction in size of the tumors which occurs with irradiation is due to destruction of the sarcomatous elements, while the tendency to recur with cessation of irradiation is due to the viability of the resistant epithelial cells.

SYMPTOMS

Wilms' tumors are characterized by their lack of symptoms. The one constant and outstanding feature is the presence of an abdominal mass, which is usually discovered accidentally by the parents or nurse, or during a routine examination by the physician. Less common symptoms are fever, gastro-intestinal complaints, and disturbances of urination. Hematuria

[1] From the Departments of Radiology of the Children's Hospital, Philadelphia, Penna., and the Bryn Mawr Hospital, Bryn Mawr, Penna. Presented at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Cleveland, Ohio, Dec. 4–9, 1949.

is not commonly present, as it is in the hypernephroma of adults. Pain is uncommon and is usually manifested as a dragging sensation due to the weight of the mass.

DIAGNOSIS

The diagnosis is based on the finding of an abdominal mass in an infant in the appropriate age group and elimination of other possible causes by intravenous and retrograde pyelography. It has been stated that an abdominal mass in an infant or young child should be considered as Wilms' tumor or neuroblastoma until proved otherwise. The pyelographic findings include mechanical distortion of the renal pelvis, obstruction of the ureter, elongation of the calyces, enlargement of the renal pelvis, non-visualization of the pelvis, and displacement of the kidney or ureter. At the Children's Hospital of Philadelphia, the greatest difficulty in differential diagnosis has been caused by the adrenal neuroblastoma, and in many cases it has not been possible to make the differentiation without an exploratory operation. This experience has been shared by other writers. Among other conditions to be differentiated are hydronephrosis, polycystic disease, solitary cyst, pelvic tumors, enlargements of the liver and spleen, and retroperitoneal sarcoma.

TREATMENT

Five basic plans of treatment of Wilms' tumor have been advocated and practised.

1. *Irradiation Alone:* Irradiation as the sole method of treatment finds its strongest advocate in Dean (16–19), of the Memorial Hospital, New York. According to him (17) irradiation was first employed in the treatment of Wilms' tumor in 1924. He believes that the survival rate would be improved if all operations were abandoned and x-ray alone were given in full doses. He stated in 1939 that he knew of only two operable cases which were treated by x-rays alone and that both patients survived and were apparently well for periods of two and five years, respectively (17). He himself reported on a series of 20 patients with Wilms' tumor treated by x-ray alone, 5 of whom survived for more than five years. This result compares favorably with any reported results from other methods of treatment, although unfortunately Dean did not state whether the diagnosis was a presumptive one or based on histological methods. Barringer (5), from the same institution, stated that he believed high-voltage x-ray therapy, if properly given, can control a certain number of cases of Wilms' tumor indefinitely. Portmann (59) called attention to the vascularity of the tumor and the inhibition of growth induced by irradiation as a result of devascularization, and said that in most instances it was advisable to depend upon irradiation alone in the treatment of the tumor. He stated that if the patient is to be operated upon, postoperative irradiation should be given.

Against the use of irradiation alone in this condition is the experience of Priestley, of the Mayo Clinic. He reviewed 39 cases of Wilms' tumor from that institution, treated prior to 1936, and was able to find no instance in which a cure resulted from irradiation alone. The statement that no case of Wilms' tumor has ever been cured solely by x-ray is commonly repeated in the literature. It appears most recently in the monograph on *The Diagnosis of Genito-Urinary Neoplasms* distributed by the American Cancer Society (45). In direct contradiction to this statement is a case described by Sauer (68), proved by biopsy, with the patient living and well ten years following delivery of a tumor dose of 6,200 r in two courses of treatment. Nesbit and Adams (55) also reported a case, proved by punch biopsy, with survival for more than ten years following irradiation. McNeill (48) had two patients surviving more than five years with irradiation as the only method of treatment, but the diagnosis in these cases was not proved histologically. Kerr (33) described two cases with a survival of more than four years following irradiation alone, in one of which a recurrence developed almost five

years after treatment. Pohle and Ritchie (58) had a proved case which was inoperable at exploration, with survival for more than six years following irradiation, with no evidence of recurrence. Bixler and Stenstrom (7) had a patient with lung metastases who was alive and apparently well three years after x-ray therapy.

Although the evidence from these scattered reports in favor of irradiation alone in the treatment of Wilms' tumor is not convincing, it must be remembered that this type of treatment is limited to inoperable cases, and cures, therefore, are not to be expected.

2. *Surgery Alone:* The foremost advocate of surgery alone in the treatment of Wilms' tumor has been Ladd at the Children's Hospital in Boston. He believes that preoperative x-ray therapy is dangerous in that it permits tumor metastases to develop during the treatment period. He does not feel that shrinking the tumor, to make it more operable, is justifiable since he believes that a tumor of any size can be removed by the transperitoneal approach. Not all surgeons share his confidence or possess his surgical skill. In favor of his opinion are his brilliant statistics (39), which show 13 survivals from a series of 54 nephrectomies without preoperative irradiation as opposed to a single survival with preoperative irradiation. He also had a series of 22 consecutive nephrectomies in an eight-year period with no operative deaths, while he had only 2 operative deaths in a series of 37 consecutive nephrectomies over a thirteen-year period. Other arguments which Ladd advances against preoperative irradiation are that he knows of no case of Wilms' tumor that has ever been cured by x-ray alone; that viable cells have been found in every kidney examined following x-ray therapy; and that primary softening of the tumor by irradiation may facilitate metastasis. Against the use of postoperative irradiation Ladd states that all patients with recurrences have died and that all specimens of recurrent tumor examined after x-ray therapy have shown viable cells. He feels that the only possible good of postoperative irradiation is for prophylaxis, and that the abdomen, lungs, and brain should be treated. He does not believe that sufficient radiation can be delivered to these areas to destroy the tumor without destroying the patient. Against these former ideas of Ladd in regard to postoperative irradiation are the most recent results obtained at the Children's Hospital in Boston, which will be discussed in connection with postoperative irradiation.

3. *Preoperative Irradiation plus Surgery:* Millin (51), in defense of preoperative irradiation, sums up the favorable arguments as follows: (*a*) Large inoperable tumors may be shrunk down to a size which makes removal easier. (*b*) Greater ease of operability reduces shock and hence lowers operative mortality.

Portmann (59) states that irradiation inhibits growth by vascular obliteration and, since Wilms' tumors are very vascular, preoperative irradiation would seem to be indicated.

Randall (65) reported a case of Wilms' tumor which was explored, found inoperable, and given irradiation. At autopsy, two years later, no trace could be found of the primary tumor or of metastases.

Rowe and Frazer (67) emphasize that the reduction in size of the tumor by preoperative irradiation lessens the danger of metastasis from too much handling of the tumor, in addition to sealing off routes of metastasis by production of vascular fibrosis. They also feel that the delay during preoperative irradiation allows time to prepare the patient for surgery by means of transfusions, etc., thus creating a better surgical risk. Wharton (77) reiterates these benefits.

4. *Surgery plus Postoperative Irradiation:* This method of therapy has been employed by those favoring immediate operation in the hope of improving the poor surgical results. It has been used in an attempt to sterilize any remaining viable cells following nephrectomy. Nesbit and Adams had two cases in which retro-

TABLE I: STATISTICS FROM BOSTON CHILDREN'S HOSPITAL SERIES OF MIXED TUMORS OF THE KIDNEY

Period of Study	Probable Cures		
	Patients Below 12 Months of Age	Patients Above 12 Months of Age	All Patients of All Ages
1914–1930 inclusive 27 cases (4 cures)	42.8%	5.0%	14.9%
1931–1939 inclusive 31 cases (10 cures)	71.4%	20.8%	32.2%
1940–1947 inclusive 38 cases (18 cures)	80.0%	43.3%	47.3%

peritoneal extension had been discovered at operation, which were treated postoperatively by irradiation, with survivals of four and eleven years, respectively, without evidence of residual disease (55). The most important support for postoperative irradiation comes from the latest statistics of the Children's Hospital in Boston (56). These figures, as quoted by Neuhauser, are reproduced in Table I. In the period 1931–1947, inclusive, there has been no important change in the surgical procedures, nor has there been any appreciable difference, according to the surgeons, in the type and size of the tumors encountered. Yet in the period from 1940 to 1947 the survival rate rose from 32.2 per cent to 47.3 per cent, although the only difference in treatment was an improvement in the amount and intensity of postoperative irradiation. These are relatively controlled figures and would seem to be highly significant.

5. *Preoperative Irradiation, Surgery, and Postoperative Irradiation:* Surgery with both preoperative and postoperative irradiation seems to be the method most commonly employed at the present time. It has all the advantages listed under preoperative irradiation, the advantages of surgical removal of the tumor, and finally the advantages of postoperative irradiation. This procedure is recommended by Kretschmer (34), Priestley (64), and many of the larger clinics. The survival rate for this type of treatment surpasses all others in the statistics to be presented as a result of this study.

STATISTICAL DATA FROM THE LITERATURE

For the present study, the English and American literature was reviewed with reference to all reported cures. Table II lists all the authors reporting survivals of more than eighteen months, with a few large series in which no survivals were noted. A period of eighteen months was chosen because Ladd found, in a study of 60 cases in which there were 32 recurrences, that 31 of the recurrences took place within nine months, and only 1 after twenty months. It is, of course, realized that recurrences may occur as late as five years after removal of a Wilms' tumor. All but one of the survivals tabulated here were of at least two years duration. The study includes 716 cases with a survival of 124 cases, or 17.3 per cent. In the same table the number of survivors has been broken down according to the treatment methods employed. The great majority of the survivals—81, or 65 per cent—followed either surgery alone or surgery plus postoperative irradiation. In only 13 survivals was the treatment by irradiation alone; in 27 irradiation was given before removal of the tumor.

Table III summarizes the survival rates with different treatment methods as reported by various authors. The total number is considerably smaller than in Table II, since many of the reports do not list the methods of treatment employed in patients not surviving. The percentage rates would doubtless be altered considerably if these figures were available. Under the circumstances, it was possible to use only those statistics in which the method of treatment was specifically stated. According to this break-down the best results (on a percentage basis) were obtained with a combination of preoperative irradiation, surgery, and postoperative irradiation. The figures for irradiation alone are not reliable as an index of the effectiveness of this form of treatment, since in most of the cases listed there is no mention as to how the diagnosis was made and it must be assumed to be on a presumptive rather than a histologic basis.

TABLE II: STATISTICAL STUDY OF REPORTED CASES OF WILMS' TUMORS

Authors	Cases	Survivors	Surgery	Irradiation	Pre- and Postoperative Irradiation plus Surgery	Preoperative Irradiation and Surgery	Surgery and Postoperative Irradiation
Adams and Hunt	3	0					
Balfour	7	0					
Bandler and Roen	31	1	1				
Bixler and Stenstrom	13	3		1	1		1
Burdick et al.	24	1	1				
Burgess	1	1					1
Campbell	29	5	2		1		
Children's Hospital, Philadelphia	10	0					
Daw	7	3			1		2
Dean	20	5		5			
Dean and Pack	15	0					
Deming	3	2	2				
DeVries	6	3			1		2
Fraser	7	1	1				
Gahagan and Yearwood	14	2			1		1
Geschickter and Widenhorn	35	0					
Higgins and Shively	26	4	2		1	1	
Hyman	17	1	1				
Kaplan and Campbell	3	1			1		
Kerr	14	2		2			
Kretschmer and Hibbs	24	3	1		1		1
Long	13	2				1	1
Loughnane	35	4	4				
Malcolm	1	1	1				
Mandeville and Nelson	1	1				1	
McNeill and Chilko	5	2		2			
Melicow	9	1			1		
Nesbit and Adams	16	8	3	1		2	2
Neuhauser	96	32	12			1	18
Ockerblad and Carlson	1	1					1
Pohle and Ritchie	6	1		1			
Prather and Friedman	1	1			1		
Priestley	44	7	1		4		2
Randall	3	1				1	
Ritter and Scott	1	1	1				
Rowe and Frazer	3	2			2		
Sauer	16	1		1			
Schenck	17	0					
Schippers	12	0					
Silver	18	10	3		4		3
Stern and Newns	24	3	3				
Wade	1	1	1				
Walker	75	4	4				
White	9	2	2				
TOTAL	716	124 (17 per cent)	46	13	20	7	35

TABLE III: SURVIVALS ACCORDING TO METHOD OF TREATMENT IN REPORTED CASES OF WILMS' TUMOR

Treatment	Total Cases	Survivals
Irradiation alone	63	10 (15.8%)
Surgery alone	180	28 (15.5%)
Preoperative irradiation and surgery	27	5 (18.5%)
Surgery and postoperative irradiation	109	33 (30%)
Preoperative irradiation, surgery, and postoperative irradiation	65	21 (32.3%)
TOTAL	444	97 (21.9%)

The five- and ten-year survivals have also been analyzed as to modes of treatment employed (Table IV). The greatest number of five- and ten-year survivals reported have followed treatment by surgery alone.

The statistics were finally broken down into two age groups to determine whether the survival rate was better in the younger infant. In Table V the survival rate in those under twelve months of age is compared with those over twelve months of

TABLE IV: REPORTED CASES OF WILMS' TUMOR WITH FIVE- AND TEN-YEAR SURVIVALS ACCORDING TO METHOD OF TREATMENT

Survival Period	Surgery Alone	Preoperative Irradiation plus Surgery	Surgery plus Postoperative Irradiation	Pre- and Postoperative Irradiation plus Surgery	Irradiation Alone
Five years	30	4	11	8	10
Ten years	19	0	3	0	2

age. A striking difference is shown, the survival rate for those under twelve months of age being 41.5 per cent and for those over twelve months of age 18.4 per cent. Although the number of cases reported under twelve months of age is much smaller, the marked discrepancy in survival rate appears significant and indicates that the prognosis of Wilms' tumor is much better in the young infant than in the older child.

TABLE V: SURVIVAL RATES OF PATIENTS WITH WILMS' TUMOR ACCORDING TO AGE

	No. of Cases	Survivals
Under twelve months	65	27 (41.5%)
Over twelve months	407	75 (18.4%)

SUMMARY AND CONCLUSIONS

A large series of cases of Wilms' tumor collected from the literature has been reviewed and broken down into various categories as to treatment methods. There is not sufficient evidence upon which to determine the proper method of treatment at this time, since no large series of cases has been adequately treated by various methods at any one institution. This is, of course, due to the fact that the disease is sufficiently rare that no one institution has access to enough cases to make a comparable study. Certain conclusions, however, seem justifiable:

1. Surgery alone is not adequate in control of Wilms' tumor.

2. Although irradiation has been proved to control some cases of Wilms' tumor for at least ten years, it also does not appear adequate for most cases.

3. Irradiation has probably not been given sufficient opportunity to demonstrate its effectiveness in operable cases of the disease.

4. The value of postoperative irradiation appears to have been established conclusively by the figures of Neuhauser.

It would seem worth while to give a large series of cases the benefit of preoperative irradiation in addition to surgery and postoperative irradiation. These cases should be so-called operable cases and not hopeless cases. This is the only means by which an adequate evaluation of this method of therapy can be made.

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SUMARIO

El Tumor de Wilms: Justipreciación de los Métodos Terapéuticos

Después de recopilar de la literatura una numerosa serie de casos de tumor de Wilms, la misma fué repasada y dividida en varias categorías conforme a los métodos terapéuticos empleados. Los datos no son suficientes para determinar todavía el método más adecuado de tratamiento, dado que en ningún establecimiento han tratado apropiadamente series considerables con varios métodos, lo cual, por supuesto, se debe a que ninguna institución tiene acceso a casos suficientes para realizar un estudio comparable. No obstante, ciertas conclusiones parecen justificables:

1. La cirugía sola no es adecuada para cohibir el tumor de Wilms.

2. Aunque está demostrado que la irradiación cohibe algunos casos de tumor de Wilms por lo menos diez años, tampoco parece adecuada para la mayor parte de los casos.

3. La irradiación no ha gozado probablemente de suficiente oportunidad para demostrar su efectividad en los casos operables de la enfermedad.

4. El valor de la irradiación postoperatoria parece establecido terminantemente en las estadísticas de Neuhauser.

Parece que vale la pena brindar a una serie numerosa de casos el beneficio de la irradiación preoperatoria unida a la cirugía y la irradiación postoperatoria. Esos casos deben ser llamados operables y no desahuciados. Esta es la única manera en que puede hacerse una valuación adecuada de este método terapéutico.

DISCUSSION

(Papers by Neuhauser, Wittenborg, and Dehlinger; Silverman; Wittenborg; Harvey)

Meredith Campbell, M.D. (New York): Doctor Wittenborg's magnificent presentation is not only most comprehensive and complete but surveys by far the largest number of cases of neuroblastoma from one institution reported to date. My discussion will be chiefly from the urologist's point of view. In considering neuroblastoma clinically, the general conception localizes this disease to the adrenal medulla but, of course, it can occur at any point along the sympathetic chain, including the superior cervical ganglia, the thoracic sympathetic tissues at the pulmonary roots, retropleural and retroperitoneal sympathetics, the organ of Zuckerkandl near the bifurcation of the iliac arteries, as well as juxta-adrenal periganglionic tissue. The extra-adrenal growths tend to be rapidly invasive and commonly involve the spine.

The distinction from Wilms' tumor often cannot be made, particularly when the growth, by extrarenal pressure, causes compression and distortion of the pelvis and dislocation of the kidney. Pronounced downward renal displacement is suggestive of neuroblastoma; urographic evidence of downward compression of the pelvis points even more strongly to that diagnosis, particularly if the tumor is unusually fast growing and invasive of the surrounding tissue and spine. The growth of paraganglioma and perirenal teratoma is slow and the location is mesial. Lymphosarcoma and acute anemia often simulate adrenal neuroblastoma and here the differential diagnosis is made in the laboratory rather than by radiologic methods. Ewing's sarcoma appears late in childhood and the onion-peel splitting of periosteal layers is usually observed. In neuroblastoma, metastases in the spine, chest, or skull (orbit, calvarium) are commonly demonstrable roentgenologically at the initial examination. In early stages of the tumor, urography generally shows a slightly displaced kidney with little or no change in the pelvic outline. Later these changes are pronounced; the ureter is compressed and/or deviated from its regular course and may even be invaded by the tumor. Yet the diagnosis is usually made at operation or autopsy.

The usual diagnosis in neuroblastoma is retro-

peritoneal sarcoma. The incidence of neuroblastoma in children nearly equals and, in the Children's Hospital series, exceeded that of Wilms' tumor, from which it must most often be differentiated. Perirenal pneumography has again achieved considerable prominence as an aid in the differential diagnosis between adrenal and nephric tumors. I have used it to a considerable extent but in recent years have almost abandoned it because of lack of indication for its employment and the comparatively lower ratio of satisfactory results obtained by the method in infants and children as compared to adults. Doubtless most of these unfavorable radiographic results are due to faulty injection of air, *i.e.*, failure to strike the proper fascial plane. In the child, in whom the perirenal fasciae are thin and fat is characteristically extremely scant, the introduction of the needle for air injection precisely into the perirenal space is largely a matter of luck rather than perfection of technic. In introducing the needle into the perirenal space of an adult, one can usually feel the click as Gerota's fascia is penetrated, but this sensation is seldom obtained in children and one rarely knows the precise location of the tip of the needle until the kidney is struck or penetrated. At any rate, the method is infinitely more dangerous in children, in whom its employment has caused several deaths, and I have largely discarded it. Dr. Reed Nesbit recently told me of the sudden death of an eight-year-old girl promptly following the injection. Yet we have several times obtained magnificent airgrams showing both the renal and the adrenal outlines. In some cases of neuroblastoma the tumor was so extensive and so intimately adherent to the surrounding structures that the injected air did not disperse along the usual anatomic planes.

Unfortunately in the urographic demonstration of neuroblastoma, the extent of the growth and the degree of invasion or encirclement of structures such as the aorta or vena cava are rarely shown. In some of our cases coming to autopsy, the great vessels were imbedded in the tumor, and in others compression of the adjacent kidney vastly diminished this organ in size. In short, the radiographic diagnosis in neuroblastoma is likely to be extremely difficult to make and erroneous and, like the surgical treatment, commonly leaves much to be desired.

While it is customary to speak of five-year cures in considering the results of treatment of malignant disease, in the mixed or Wilms' renal tumors of children it seems to me that if the tumor has not recurred twelve months after operation we have a situation equally favorable or even more so than the five-year test of cure of carcinoma in adults.

Three weeks ago I heard Dr. Robert Gross report the experience at the Boston Children's Hospital in a paper given before the New York Urological Society. As Doctor Harvey has indicated, Doctor Gross and his associates at the Children's Hospital have shown an astoundingly high percentage of surgical cures (80 per cent) in children with Wilms' tumor operated upon during the first year of life. Since this is a congenital tumor, it stands to reason that, in general, the earlier in life it is recognized and operated upon the greater the expectancy of cure. Yet many of these tumors have not started to enlarge at this early age and countless others pass unrecognized for want of careful examination. Doctor Gross noted that discovery of the abdominal mass during the first year becomes more likely because of the increased handling of the child during this period by the mother or nurse. Certainly at no other time in the child's life is he likely to be so closely watched, felt, and manipulated as in early infancy.

It is notable that, while Doctor Gross and his associates did not employ preoperative irradiation in the past, but proceeded at once to removal of the tumor as soon as the child was suitably prepared for operation, they have come, as Doctor Harvey has noted, to employ this agent postoperatively, with unquestioned benefit in many cases. Having established a base line by observation of 60 or more cases treated with no irradiation, they are now, most creditably, making parallel observations on the use of preoperative and postoperative irradiation. It is only from such studies, in clinics where large numbers of these cases are seen, that cogent data for the guidance of all will be obtained.

This swing to combined surgical and irradiation therapy at the Children's Hospital is interesting to me, since I have felt it is usually the thing to do. Yet Dr. Archie Dean of the Memorial Hospital in New York has largely transferred his preference from irradiation to reliance chiefly on surgery as formerly advocated by Doctors Ladd and Gross. In my own work I have employed preoperative irradiation rather liberally in cases of extremely large tumors, having seen several children die of shock as a result of the sudden abdominal decompression consequent to removal of a large renal mass which, in some instances, accounted for a third to a fifth of the body weight. Moreover, death from shock occurred in a thirteen-month-old girl in whom I merely drained a large perirenal cyst. Yet most of these personal experiences occurred at the same time that the surgical mortality at the Children's Hospital was 23 per cent and, with improvement in surgical care, the operative mortality has comparably diminished in later years. We have employed preoperative irradiation for only a brief period, and rarely with more than 1,500 r, merely to shrink the tumor and facilitate its removal and correspondingly reduce the likelihood of evacuation surgical shock. I see no objection to a delay

of a week or so for irradiation if this is indicated by reason of the tumor size, since the size of the tumor and the probability of metastases are not necessarily reciprocal.

While the number of cases of mixed renal tumors I have been fortunate enough to see is meager beside the hundred mark in the experience of the Children's Hospital in Boston, a goodly number have been encountered in private consultation and on services in various hospitals, with which I had no further contact. I have actually operated on and personally seen through the therapeutic course only 24, mostly in private patients, of whom 8 are living and apparently well two or more years since operation, the longest periods being fourteen and sixteen years. None was denied operation even though the outlook seemed hopeless and in one instance the tumor was bilateral. Although this incidence of apparent cures is higher than observations reported by many surgeons and the 95 per cent mortality prediction of older literature, all cases should be included whether or not operation is performed, and this I have done because my personal contact with other cases I have been privileged to see was extremely tangential, with little or no hand in the clinical management.

In the youngest child I have treated surgically, the tumor was discovered at five weeks, complete urologic examination was carried out, and a week later nephrectomy was performed. This child is alive and well sixteen years later. In another patient, a girl of six years, extensive metastatic tumor nodes were observed about the renal hilus and extending on both sides of the pedicle. The readily accessible and histologically tumor-bearing nodes were excised and intensive postoperative irradiation therapy was given to the operative region as well as to the chest, chiefly the mediastinum. This patient has shown mild calcification of some of the remaining nodes and there is no evidence of tumor recurrence four years postoperative. In this case, as in several at the Children's Hospital, the postoperative irradiation appears probably to have been of vital importance. Thus it seems likely that irradiation therapy should be employed postoperatively and that it may advantageously be given briefly before operation for tumor shrinkage. In the 6 of the 8 surviving patients in my small series who were irradiated preoperatively, the tumor was readily removed through the lumbar approach.

In the employment of irradiation therapy, extreme caution must be observed not to damage the opposite organ. In 3 of my personal cases there was severe irradiation damage of the remaining kidney and in 2 of these it was fatal. In one, there is every reason to believe that cure of the malignant disease would have been achieved. In this eighteen-month-old boy, preoperative irradiation had been given, followed by left nephrectomy, at which time no evidence of vascular invasion was apparent nor was it found histologically. On the eighth day, when the boy was to be discharged home, he had a profuse hematuria followed by anuria. Ureteral catheterization and pelvic lavage availed nothing; the anuria persisted, decapsulation was carried out, and microscopic examination of a biopsy specimen removed from the remaining kidney was histologically reported as acute irradiation nephritis. At any rate, the anuric boy died in forty-eight hours. In a second boy, death occurred one month postoperative with acute nephritis attributed to irradiation therapy. In a third case, in a child operated on at the age of two years, a physician's daughter, preoperative irradiation of the left kidney rapidly shrank a massive Wilms' tumor. Nephrectomy was uneventful and the child is alive and apparently tumor-free five years later, but since operation she has shown a chronic nephritis with hypertensive vascular disease and, distinctly attributed to irradiation, damage of the remaining kidney. Because of nephritic anemia and possibly bone marrow injury, she requires transfusion every three months. Each of these three children had received irradiation therapy in a different hospital. These observations are mentioned not only to emphasize the potential danger this medium exhibits when not precisely controlled but because, in studying the literature, I have not seen this point elaborated by specific case records until Doctor Wittenborg cited cases today.

James F. Martin, M.D. (Cleveland, Ohio): The symposium today has presented interesting and comprehensive studies of some of the more complex problems encountered in an institution devoted to the care of babies and children.

Dr. Neuhauser is to be congratulated for his excellent study of a condition which was little recognized before 1940. He has brought to all of us the realization that developmental anomalies of the spine deserve a more critical study in the hope that we may recognize this abnormality in which surgery offers considerable aid. To me, it has been stimulating to see his study and to hear his comments.

Dr. Silverman has presented an interesting historic review of the development of aminopterin. It is one of the first drugs which has been shown to influence the course of leukemia in children. To date, we have used it in 30 patients at the Babies' and Children's Hospital in Cleveland. Twenty-nine patients had roentgen studies of the long bones. Eleven had adequate serial examinations to permit an evaluation of the changes that occurred in the skeletal system. Approximately 70 per cent of our cases had clinical and hematogical remissions during therapy with aminopterin. There was evidence of regression of the bone lesions following therapy in approximately 30 per cent of the cases, while in several instances the

drug had little effect in preventing the appearance of new areas of destruction or in promoting healing of those already present. We have seen new lesions develop during treatment even though there was a marked clinical improvement during this period. We believe the transverse bands of increased density, described by Dr. Silverman, most likely represent evidence of improvement in the metabolism and nutrition during a remission rather than a specific aminopterin effect, for we have observed this change in a leukemic patient who had received no specific therapy.

We used P^{32} in several cases of acute leukemia in childhood prior to the advent of aminopterin and were quite impressed by the favorable response of a ten-year-old girl. At the time of admission, in November 1946, the patient was confined to bed because of pain in the back and pelvis. Roentgenograms of the dorsal and lumbar spine revealed marked generalized osteoporosis, thinning of the vertebral end-plates, and wedging of the anterior margins of most of the vertebral bodies. Fine mottled areas of destruction were present in the pelvis. One month after P^{32} was given the child was able to return gradually to her normal activities, aided by a back brace. She died seven months after the diagnosis was made and, although it was not possible to determine definitely whether or not the therapy prolonged life, it was quite effective in relieving pain and improving the roentgen appearance of the lumbar and dorsal vertebral bodies. Our experience with P^{32} in acute leukemia is, however, too limited to permit evaluation of this form of therapy, and aminopterin has replaced it completely so that further observations appear unlikely.

Aminopterin appears to be the drug of choice at present, but its effect is only temporary. It is to be hoped that further study will provide us with a more effective therapeutic agent.

Sydney F. Thomas, M.D. (Menlo Park, Calif.): Just one comment on the transverse lines which Dr. Silverman has described in cases treated with aminopterin. These bone changes may be seen in a variety of diseases. They have also been demonstrated very beautifully following irradiation of the bones plus malnutrition, as in the children of Nagasaki. I would suggest a much less specific cause than aminopterin.

Dr. Silverman (*closing*): I am very grateful to the discussants for their comments. I should like to point out that the non-specificity of the transverse lines which we have been describing has been stressed. I am glad to see that other people recognize their non-specificity. They occur, as was said, in heavy metal poisoning, in severe illness, and as a response to many factors which are as yet not understood. We also observe them in children being treated with aminopterin and we see them in children with leukemia who do not get aminopterin.

I believe aminopterin has given us a tool to investigate the longitudinal growth of bone and one which suggests that the formation of the transverse line or band is not necessarily related to an arrest of growth; generally transverse lines have been considered evidence of arrested growth due to a disturbance in nutrition.

I feel our observations here may indicate one technic whereby we can study transverse line formation further and clarify this problem.

With respect to the variations in transverse line formation in one series or another, I think that is very much akin to the variations in response to aminopterin therapy in each of the small series reported. Leukemia is a generalized disease with localizations in different parts of the body, and the variations of the disease itself may depend upon the localization. In the same way the variations of the disease may alter the response of growing bone (1) to the disease, (2) to the effect of the disease, and (3) to the therapy employed.

It is rather interesting that some of Dr. Martin's patients showed neither transverse lines nor regression of skeletal lesions. I think this is particularly interesting since it has been suggested by Dr. Farber that morphologic classification of leukemia leaves something to the imagination and that another classification which might be offered would be one of response of the disease to various types of therapy. In that way, we might be able to differentiate different types of the disease and perhaps get some more basic information.

The Pulmonary Air Meniscus[1]

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Atlanta, Ga.

SPORADICALLY, there have been recorded in the literature cases in which chest roentgenograms disclosed a rounded pulmonary density surmounted by a crescent-shaped air shadow. The appearance of this roentgenographic image is sufficiently characteristic that various investigators have considered it as a radiologic sign, describing it under a variety of terms, such as *la calotte aérienne*, *neumoquiste perivesicular*, *halo claro lineal*, air cap, and air crescent (1). Inasmuch as it has the configuration of a convergent meniscus, this air shadow may be referred to as the sign of the pulmonary air meniscus.

A review of the literature reveals that this radiologic finding is not a pathognomonic one, since it has been demonstrated in a limited number of pulmonary disorders. Nevertheless, with careful correlation of clinical and roentgen observations, it is frequently possible to establish a correct diagnosis.

In view of the fact that most of the reports of the pulmonary air meniscus have appeared in the foreign literature, it was considered worth while to present the following three cases in which this singular roentgenographic finding was demonstrated to advantage.

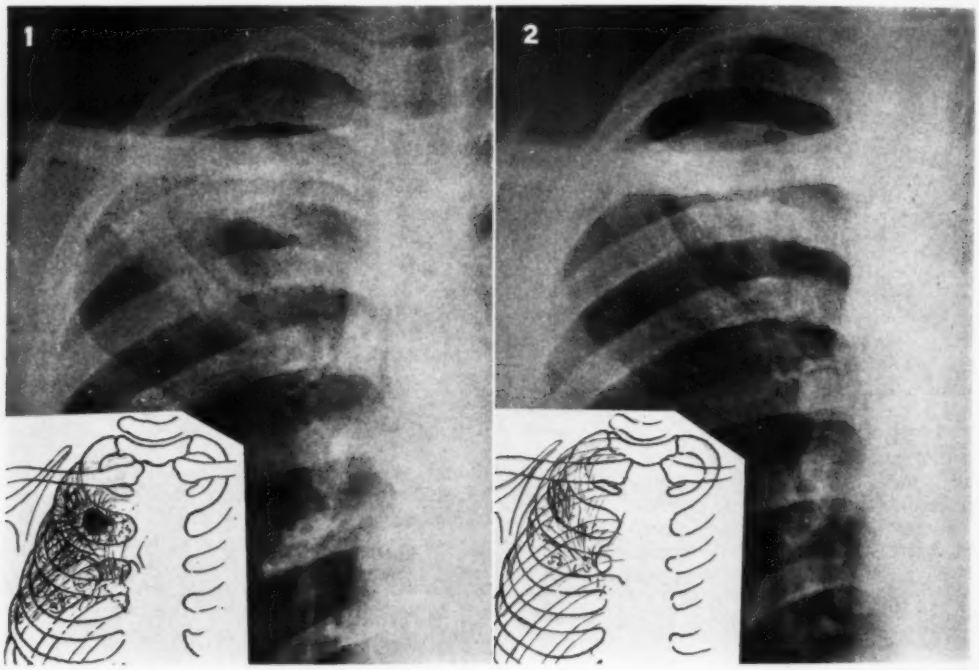

Fig. 1. Case I. Chest roentgenogram demonstrating abscess cavity in right upper lobe.
Fig. 2. Case I. Roentgenogram made ten days after the original study, demonstrating disappearance of the cavity.

[1] From the Department of Roentgenology, Emory University School of Medicine and Grady Memorial Hospital, Atlanta, Ga. Accepted for publication in June 1949.

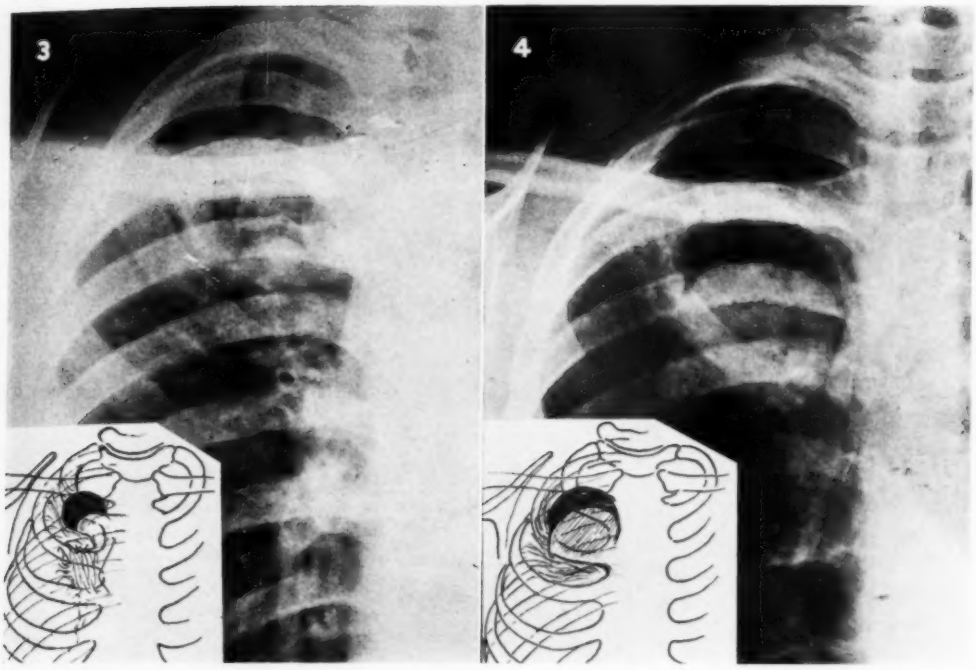

Fig. 3. Case I. Reappearance of the cavity. A small nodular mass has now developed at its base.
Fig. 4. Case I. Roentgenogram showing increase in size of nodular mass shown in Fig. 3, which is now encroaching upon the air space of the cavity.

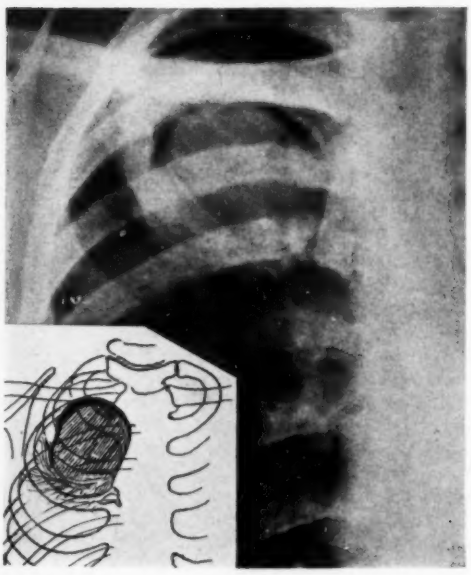

Fig. 5. Case I. The cavity in the right upper lobe is now almost completely filled by the enlarging mass. The typical pulmonary air meniscus is well shown.

The significance of this phenomenon with reference to those conditions in which it may occur will be briefly discussed.

CASE I: A 24-year-old colored male was admitted to the Grady Memorial Hospital in 1942 with a one-week history of hemoptysis, chills, fever, night sweats, and right chest pain. Blood cultures were negative and sputum examination showed no evidence of acid-fast organisms. The chest roentgenogram obtained a few days after admission showed an abscess cavity in the right upper lobe surrounded by a rather homogeneous area of consolidation (Fig. 1). The patient improved clinically on sulfathiazole therapy, and the x-ray examination ten days later demonstrated considerable clearing of the process, with disappearance of the cavity (Fig. 2). Roentgen studies several weeks after the original admission again disclosed a small cavity, which now contained a small rounded density in its base (Fig. 3).

Three months later the patient was readmitted to the hospital because of progressively increasing productive cough, night sweats, and right chest pain. Bronchoscopy at this time demonstrated an erythematous carina, with exudate coming from the right upper lobe bronchus. Both the cavity and the rounded mass in its base had increased in size (Fig. 4). A crescent-shaped air shadow surmounting

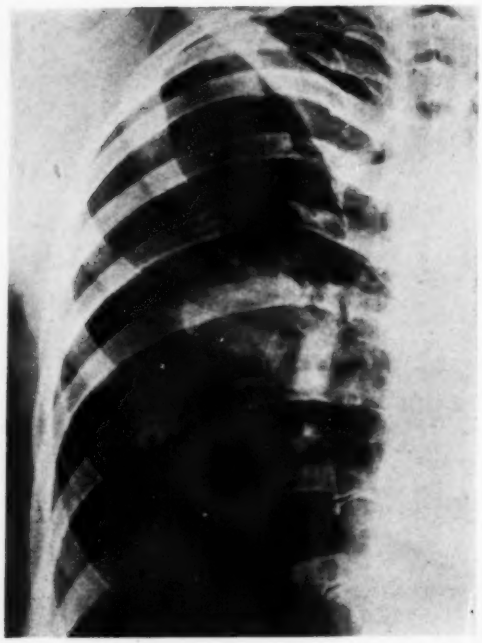

Fig. 6. Case II. The pulmonary air meniscus is seen surmounting a ball of mycelia in a "bronchogenic" cyst.

the area of density was well visualized on the film shortly before exploratory thoracotomy (Fig. 5). The pathologic examination of the surgical specimen showed a chronic abscess of the right upper lobe containing inspissated debris. No ephithelial lining of the cavity wall was demonstrated.

CASE II: A 42-year-old white woman was admitted to the Emory University Hospital in 1947, complaining of a "lump in the throat." There was a history of a cough productive of a small quantity of white mucoid sputum and two episodes of transitory, sharp, cramping subxiphoid pain. The only positive physical finding referable to the chest was a grade II apical systolic murmur transmitted to the neck. Roentgen studies of the chest demonstrated infiltration in the lower lobe of the right lung with a circumscribed area of density in the superior division of this lobe. A crescent-shaped collection of air was seen lying just superior to this rounded shadow (Fig. 6). Bronchoscopy revealed a small amount of exudate draining from the superior division of the right lower lobe. No acid-fast organisms or tumor cells were found in the bronchial washings. However, one granule of an unidentified fungus was discovered.

A segmental lobectomy was performed, and a large smooth-walled cyst measuring 5.0 × 3.5 × 3.0 cm. was removed (Fig. 7). On microscopic examination, the wall of the cavity was found to be lined with ciliated columnar epithelium, with some squamous metaplasia. The semisolid contents consisted

Fig. 7. Case II. Surgical specimen (segmental lobectomy). The ball of fungus lies loosely in the cystic cavity.

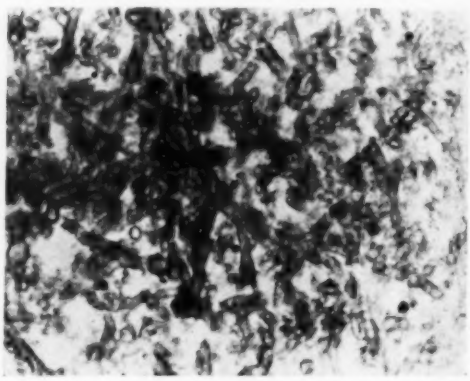

Fig. 8. Case II. Photomicrograph of mycelia found in the cystic cavity. ×*c.* 500.

entirely of large branching mycelia, which were reported as being larger than those of common pathogenic fungi (Fig. 8). No identifying spore formation was found.

CASE III: A 41-year-old white salesman was admitted to the Emory University Hospital in 1949 with hemoptysis of two weeks duration. In 1937 he had been hospitalized for twenty-two months with a diagnosis of pulmonary tuberculosis. Repeated sputum examinations were reported as negative for acid-fast organisms. On two different occasions in the intervening years the patient had been examined elsewhere and told that he had cystic lung disease without pulmonary tuberculosis. He had been active and had had no unusual physical complaints until the present episode of hemoptysis.

On admission, the patient appeared acutely ill. Coarse rhonchi were heard throughout the chest,

more pronounced on the left. Marked clubbing of the fingers and toes was noted, but there was no cyanosis or edema. The patient stated that the bleeding was coming from the left lung. The roentgen examination disclosed numerous cyst-like structures throughout both lung fields, most extensive in the apices. A large cavity measuring approximately 5 cm. in diameter was observed in the left upper lung field adjacent to the mediastinum. Within this cavity, almost completely filling it, was an oval area of homogeneous density and smooth contour. Surrounding the mass in the cavity was a thin crescent-shaped air shadow (Fig. 9). Bronchography disclosed extensive cystic bronchiectasis throughout both lungs. None of the contrast medium entered the large cavity mentioned above. On bronchoscopy, purulent exudate was noted in all visualized bronchi.

The pathologic examination of the exudate revealed many inflammatory cells and large masses of erythrocytes and fibrin. No acid-fast organisms were found. In one section a fungus consisting of mycelia and spores consistent with the Actinomyces group was noted. The patient improved clinically under conservative therapy.

Fig. 9. Case III: Cystic disease of the lung. A large cavity in the left upper lobe is almost completely filled by an ovoid mass. The pulmonary air meniscus is well demonstrated.

DISCUSSION

The crescent-shaped air shadow was first recognized by Zehbe (2) in 1916 in a case of a pulmonary echinococcus cyst. Apparently little attention was paid to this phenomenon until 1933, when Caeiro and Goyena (3) re-emphasized its merit in the diagnosis of hydatid disease of the lung. Thereafter the sign was repeatedly described as a pathognomonic feature of intrathoracic hydatid cysts.

The wall of an echinococcus cyst is usually of a composite nature. The inner germinal and cuticular layers are formed by the parasite itself, whereas, the outer layer or adventitia is furnished by the host organ (4). In this disease the air cap apparently occurs as the result of a bronchial fistula opening into the potential space between the outer wall of the parasite and the adventitia formed by the adjacent compressed lung parenchyma. This shadow usually consists of a very thin layer of air, which in some instances has been noted to disappear temporarily.

Dévé (5), who has studied echinococcus disease extensively, deserves credit for having shown that the sign of the air meniscus, although highly characteristic, is not pathognomonic for pulmonary hydatid cyst. As an "exception to the rule" he describes the case of a patient with a large bronchiectatic cavity in whom the crescent-shaped air shadow was observed for several years. The semisolid contents of this cavity were proved to be composed of the mycelia of a fungus (*Aspergillus*). Subsequently a number of similar observations were reported in which this phenomenon was not associated with echinococcus disease (6–9, 11).

Métras and Thomas (7) described three cases showing the sign of the air meniscus, which were considered to be bronchiectatic megamycetoma, though proof of the diagnosis was obtained in only one.

The roentgen findings in our second and third patients bear a close resemblance to those described by Dévé and by Métras and Thomas. It appears doubtful to us that the growth of the fungus was the primary cause of the disease in these instances, since there was no invasion of the

surrounding lung parenchyma. It is conceivable, however, that the mycelia forming the large foreign body may have been a contributing factor in the maintenance and expansion of a preformed cavity. It remains in the realm of speculation that the presence of the fungus may have inhibited the growth of other organisms.

In another group of reports the described radiologic image could be attributed to inspissation of necrotic or purulent material accumulating in a preformed abscess, bronchiectatic cavity, or bronchogenic cyst. As long as there is unimpaired bronchial drainage from these structures, there may be little accumulation of fluid, debris, or micro-organisms. Should partial bronchial obstruction occur, desquamation products and micro-organisms within the cavity may be retained. With absorption of fluid, these substances may become inspissated and assume a configuration which is largely determined by the inner contour of the cavity. Frequently the desiccated material is surrounded by a thin layer of air which is roentgenographically visible as an air meniscus.

Cases described by Robbins (Case E. B.) (8) and Bobrowitz (Case 1) (9), as well as our Case I, may be considered as representative examples of this process. In this connection it may be pointed out that it is frequently impossible to state whether a pulmonary cyst is congenital or acquired (10). Many pulmonary cysts result from the epithelization of abscess or bronchiectatic cavities. In rare instances a pulmonary air meniscus may also be produced by an inspissated blood clot (9) or a Rasmussen aneurysm (11).

A differential diagnosis of these conditions will be difficult or impossible from a roentgen examination alone. The air layer covering an echinococcus cyst is usually a delicate one and may be present for only a limited period of time. The air shadow contained in an abscess cavity or cyst may, however, exist for months or years, showing little change in appearance. In one of our cases (Case II) the intracavitary mycelia formed a loose foreign body, the free mobility of which could have been readily demonstrated radiographically by studying the patient in recumbent and inclined positions.

SUMMARY

The pulmonary air meniscus is a radiologic sign consisting of a crescent-shaped air shadow surmounting a rounded area of density in the lung parenchyma.

This phenomenon has been observed in a limited number of pulmonary disorders, notably hydatid disease and pulmonary cysts and abscesses. The pathologic anatomic changes causing this radiologic entity are briefly discussed with reference to these conditions.

Three cases are described in which this sign is illustrated to advantage. In the first patient its development was studied by serial roentgenograms. The rounded density was proved to be inspissated material contained in a lung abscess cavity. In the second instance a ball of mycelia of a fungus produced a rounded mass in a bronchogenic cyst. In a third case, unproved, an ovoid aggregate of fungus was likewise believed to be present in a preexisting bronchiectatic cavity.

NOTE: The authors wish to express their appreciation for the cooperation of Dr. E. L. Bishop in reviewing the microscopic sections and the preparation of the photomicrograph.

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SUMARIO

El Menisco Aéreo del Pulmón

El menisco aéreo del pulmón es un signo radiológico que consiste en una sombra de aire en forma semilunar que corona una zona redondeada de condensación en el parénquima pulmonar, habiendo sido observado en un pequeño grupo de trastornos pulmonares, y notablemente hidatidosis y quistes y abscesos pulmonares.

Descríbense 3 casos que ponen bien de manifiesto el signo. En el primer enfermo, estudióse el desenvolvimiento del mismo con roentgenogramas seriados. La condensación redondeada resultó ser materias espesadas contenidas en la cavidad de un absceso pulmonar. En el segundo caso, una bola de micelios produjo una tumefacción redondeada en un quiste bronquiógeno. En el tercero caso, no comprobado, también parecía que había presente una congregación ovoidea de hongos en una caverna bronquiectática preexistente.

En el segundo y tercer casos, parece dudoso que la proliferación del hongo fuera la causa primaria de la neumopatía, aunque cabe concebir que la gran masa de micelios fuera un factor contribuidor en el mantenimiento y expansión de una cavidad preformada.

Chordomas: A Roentgenologic Study of Sixteen Cases Previously Unreported[1]

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CHORDOMAS ARE neoplasms of relatively low malignancy which arise from remnants of the notochord. Almost all patients with chordomas require radiologic examination at some time during the course of the disease. Except for the lesions of the nasopharynx and sacrum, which may be detected by inspection and palpation, roentgenography affords the best opportunity to make the correct diagnosis prior to operation. It is the purpose of this paper to review, in summary, the records of 16 cases of histologically proved chordoma previously unreported in the literature and to discuss the roentgenologic abnormalities which help to differentiate these tumors from other neoplasms of the axial skeleton.

INCIDENCE

Chordomas are rare tumors. For almost a century, from the time Luschka (11) described gelatinous excrescences projecting from the basisphenoid (1856) until 1944, a total of 252 chordomas were described in the literature. Reports of the tumor are to be found more commonly in recent literature than in the past.

Chordomas may occur at any point in the axial skeleton, from within the skull to the coccyx. Of the 252 cases collected from the literature by Faust, Gilmore, and Mudgett (7), approximately 37 per cent were cranial, 13 per cent were vertebral, 48 per cent were sacrococcygeal, and the remaining few were eccentric.

The tumors occur twice as frequently in men as in women.

Mabrey (12) found that cranial chordomas appeared most frequently during the third and fourth decades of life, while the sacral tumors were seen more commonly during the fifth and sixth decades. The infrequent occurrence of these tumors in children is not well understood, especially in view of their relationship to tissues prominent during fetal life.

DEVELOPMENTAL AND PATHOLOGIC ANATOMY

The notochord, which forms the primitive central skeleton of all vertebrates, extends as a cylindrical rod from the buccopharyngeal membrane to the coccyx. As the embryo develops, mesodermal tissue surrounds the notochord to form the vertebrae and intervertebral disks. The intravertebral portion disappears, except for rare chordal vestiges, while the intervertebral portion normally remains as the nucleus pulposus of the intervertebral disks. The cephalic portion of the notochord forms a sigmoid curve through the basal plate of the skull in the midsagittal plane so that, following regression, cell rests may be found along the dorsal surface of the clivus intracranially, within the clivus, or in the retropharyngeal tissues.

Horwitz (9), from a study of fifty human embryos and fetuses, concluded that heterotopic chordal vestiges may undergo neoplastic metaplasia more readily than normal remnants, as the topographic distribution of the former corresponded closely to the sites of occurrence of chordomas. The ectopic vestiges of the notochord normally regress with advancing age. Schmorl (16) demonstrated chordal remnants in 9 adult cadavers in the dissection of over 3,000 human vertebral columns. It is of interest that in 6 specimens the chordal remnants were placed posteriorly, in 2 specimens centrally, and in 1 instance laterally in the vertebral bodies.

Chordomas are described by Stout (18)

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as slowly growing malignant tumors. Typically, the neoplasms are rounded or lobulated masses of soft, gelatinous tissue with areas of hemorrhage, necrosis, cystic degeneration, and calcification (Fig. 1). Initially the growths are encapsulated, but later they break through the capsule and invade the adjacent bone and soft tissues. Fragments of detached cartilage and sequestrated osseous tissue are observed in regions where the tumor has invaded bone.

Microscopically, chordomas resemble the tissue of the embryonic notochord. They are composed of large polyhedral cells with small nuclei and vacuolated cytoplasm distended with glycogen and mucin-like material. The cells are arranged in cords, irregular columns, or clusters, which are separated by fine connective-tissue trabeculae. The most characteristic feature is the vacuolated appearance of the cytoplasm.

Metastasis occurs only from those tumors which arise in the sacrococcygeal area. For some unknown reason, those which have their origin elsewhere apparently do not metastasize. Mabrey (12) reported 10 cases with metastases from a group of 16 sacrococcygeal chordomas with postmortem examinations, an incidence of 62.5 per cent. Regional lymph nodes are the most frequent site of metastases.. Bloodborne metastases in the liver, lungs, pleura, peritoneum, and other organs have been observed less frequently.

ROENTGENOLOGIC INVESTIGATION

Discussion of chordomas is found infrequently in the roentgenologic literature. The majority of articles are based upon the study of isolated cases or small series. While the roentgen manifestations of sacral chordomas have been described in some detail, the changes occurring with chordomas of the clivus and the vertebrae are less well defined.

Intracranial chordomas were described by Dyke (6) and by Brailsford (2) as characteristically invading and destroying the basisphenoid and basiocciput. Calcification in these tumors was regarded as rare. Moderate enlargement of the sella turcica was considered a usual finding, but the ballooning of the sella turcica, typically seen with primary pituitary tumors, was said by Schwartz (17) to be absent with chordomas.

Roentgenologic abnormalities resulting from cranial chordomas are not restricted to the region of the clivus and sella turcica. In one case, examined by Pancoast, Pendergrass, and Schaeffer (14), the tumor filled the left middle fossa, destroyed the greater sphenoid wing, and extended as far forward as the ethmoid sinuses. Bone destruction may occur at the foramen magnum or in the lateral portion of the occipital bone. A protrusion into the nasopharyngeal air shadow may be visible; this results from primary nasopharyngeal chordoma or secondary extension from the clivus and cervical spine. Reports in the literature have not emphasized sufficiently the value of pneumoencephalography in the diagnosis of chordoma.

Few descriptions of the roentgenologic changes occurring with vertebral chordomas have been published. Bone destruction resulting from infiltration by tumor was described by Dyke (5) as the predominant manifestation. First the vertebral body, then the arch, are destroyed, with eventual collapse of the vertebra. The involvement of several adjacent vertebrae was thought by Dyke to be more frequent with chordoma than with any other type of malignant disease. Myelography may disclose evidence of a tumor within the vertebral canal in some instances. A case of this type is illustrated by Wood (19). An obstruction to the flow of opaque medium usually is found. At the point of obstruction, the subarachnoid space is narrowed in the gradual manner observed with any extradural neoplasm.

The roentgenologic abnormalities accompanying sacrococcygeal chordoma were enumerated by Hsieh and Hsieh (10). Bone expansion, best shown in lateral projections, was described as a common feature of sacral chordoma in the early stages. Destruction of osseous structures

TABLE I: SUMMARY OF CASE HISTORIES OF 16 PATIENTS WITH CHORDOMA

Case No.	Age and Sex	Location	Complaint	Duration	Physical Examination	Treatment	Duration of Disease	Result
I	52 M	Clivus	Diplopia Headache Nausea	9 mo. 5 mo. 5 mo.	Lt. oculomotor and abducens paresis Lt. hyperreflexia Ataxic gait	Radiotherapy Surgery	2 1/2 yr.	Died
II	53 F	Clivus	Headache Diplopia Impaired vision	8 mo.	Rt. anopia Bilateral abducens paresis	Surgery Radiotherapy	1 yr.	Living with disease
III	13 F	Clivus	Headache Blindness	13 mo.	Bilateral optic atrophy Papilledema Lt. abducens paresis	Surgery	3 yr.	Died
IV	40 M	Clivus	Headache Impaired vision Pain lt. eye	24 mo. 12 mo. 3 mo.	Lt. anopia Lt. abducens paresis	Surgery Radiotherapy	10 3/4 yr.	Living. No complaints
V	49 M	Clivus	Headache Ptosis rt. lid Blind rt. eye	12 mo. 7 mo. 2 mo.	Rt. oculomotor, trochlear, and abducens paresis	Surgery Radiotherapy	2 yr.	Died
VI	64 F	Clivus	Anosmia Impaired vision Headache	24 mo. 18 mo. 2 mo.	Rt. optic atrophy Rt. oculomotor and abducens paresis	Surgery	1 3/4 yr.	Died
VII	36 F	Clivus	Impaired vision Headache	3 mo. 1 mo.	Bilateral optic atrophy Bitemporal hemianopia	Surgery Radiotherapy	6 yr.	Died
VIII	11 M	Nasopharynx	Nasal obstruction Diplopia	12 mo. 1 mo.	Nasopharyngeal mass Lt. oculomotor, abducens, and facial paresis	Radiotherapy	4 yr.	Living with disease
IX	29 F	Vertebral C-3 & 4	Cervical pain Weakness rt. arm	8 yr. 2 mo.	Rt. spastic hemiparesis Lt. hemihypalgesia	Surgery	8 yr.	Lost from follow-up
X	54 M	Vertebral T-10 & 11	Pain lt. hip	4 mo.	Lt. lower extremity hyporeflexia	Surgery Radiotherapy	1 1/4 yr.	Died
XI	41 M	Vertebral L-2, 3 & 4	Low back pain Abdominal mass	4 yr. 5 mo.	Rt. lower extremity hyporeflexia Abdominal mass	Radiotherapy	4 yr.	Died
XII	60 M	Vertebral L-4 & 5	Low back pain	24 mo.	Bilateral lower extremity muscle atrophy Sensory deficit below 3rd lumbar dermatome	Surgery Radiotherapy	6 1/3 yr.	Referred for terminal care
XIII	36 M	Vertebral L-5 & S-1	Sacral pain	24 mo.	Flaccid paraplegia	Surgery Radiotherapy	1 1/2 yr.	Lost from follow-up. Presumed dead.
XIV	37 M	Sacral S-3	Sacral pain Constipation	14 mo. 2 mo.	Sacral mass	Radiotherapy	2 1/4 yr.	Lost from follow-up
XV	55 M	Sacral S-3, 4 & 5	Constipation Sacral pain	24 mo. 3 mo.	Sacral & pelvic mass	Radiotherapy	6 1/2 yr.	Died
XVI	54 M	Sacrococcygeal S-3, 4, 5, & coccyx	Sacral pain Sphincteric disturbances	18 mo. 2 mo.	Sacral & pelvic mass	Radiotherapy	6 3/4 yr.	Died

may be pronounced, however, at any time. A sharply defined soft-tissue mass adjacent to, or superimposed upon, the sacrum may be disclosed roentgenologically, in which bony remnants or amorphous calcification may be demonstrated. Similar roentgenologic changes were found by Camp and Good (3) in 10 patients with sacral chordomas.

MATERIAL

During the last twenty years, 16 patients with pathologically verified chordomas have been seen at the Columbia-Presbyterian Medical Center. Of this group, 13 primarily entered the Neurological Institute because of symptoms referable to the nervous system. The tumors appeared or occurred in the clivus in 7 patients, in the nasopharynx in 1, in the vertebrae in 5, and in the sacrococcygeal region in 3 (Table 1).

Among the patients with clivus chordomas, osteolysis of various portions of the sphenoid bone was the most conspicuous abnormality disclosed by plain roentgenograms of the skull (Table II). In each of 7 cases there was destruction of the clivus, dorsum sellae, posterior clinoid process, and sellar floor, and neoplastic invasion of the sphenoid sinuses. Secondary extension of the tumor into the nasopharynx was demonstrable in 2 instances and extension of the tumor into the ethmoid sinuses was found in 1 case. Special views of the optic foramina were made in 5 cases and none showed an abnormality.

Intracranial calcium shadows adjacent to the area of bone destruction were demonstrable in 6 of the 7 patients with clivus chordomas (Fig. 2). In one instance (Case I) necropsy disclosed fragments of bone within the tumor, presumably derived from the base of the skull, which accounted for the shadows visible in the roentgenograms. Another specimen removed at operation showed microscopic evidence of hemorrhage, fibrosis, hyalinization, chondrification, and calcification within the tumor itself (Case III). Thus, the calcium visible in the roentgenograms may be the result of inclusion of sequestrated bone fragments in the tumor or degenerative changes in the neoplasm.

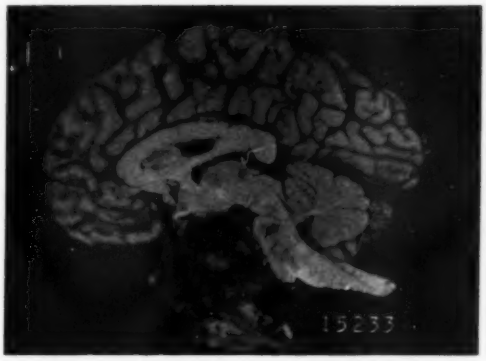

Fig. 1. Case I: Clivus chordoma in mid-sagittal section. A lobulated tumor, the bulk of which projects posteriorly, is present at the clivus. The brain stem in the pontine region is compressed and the ventral surface of the pons is flattened. The anterior portion of the neoplasm fills the pituitary fossa and enters the sphenoid sinuses. A mass extends above the sella turcica, over which the optic chiasm is bowed and compressed.

Microscopically, the tumor presented the appearance of primitive cartilage. Areas of hemorrhage, necrosis, and cyst formation were present. Numerous bone trabeculae, presumably remnants of bone invaded by tumor, were included in the neoplastic mass.

Pneumoencephalography, ventriculography, or both, were performed in 5 of the 7 cases of clivus chordomas. In 2 cases, ventriculography disclosed obstruction of the cerebral aqueduct near its junction with the third ventricle. In 1 instance in which encephalography was done, ventricular filling was not produced, although the cranial subarachnoid space was outlined.

Consistent abnormalities were disclosed in the roentgenograms whenever the third ventricle, cerebral aqueduct, fourth ventricle, or subarachnoid cisterns were outlined by gas (Table II). The third ventricle was visible at 4 examinations. In every instance, the ventricular floor was displaced upward and the hypothalamic portion of the ventricle failed to fill with gas in the usual manner. The aqueduct of Sylvius and the fourth ventricle were visible and displaced backward in 2 instances.

A filling defect in the contrast outline of the basal cisterns was disclosed in each of 4 cases in which subarachnoid gas was visible. The tumor was distinctly delin-

TABLE II: ROENTGENOLOGIC FINDINGS IN 7 PATIENTS WITH CLIVUS CHORDOMA

Case	Plain Films: Osteolysis: Clivus	Dorsum Sellae	Posterior Clinoids	Sellar Floor	Tuberculum Sellae	Anterior Clinoids	Sphenoid Wings	Pterygoid Process	Petrous Bones	Plain Films: Invasion: Sphenoid Sinuses	Nasopharynx	Ethmoid Sinuses	Optic Foramina	Calcification	Encephalograms: Type Study	Obstruction	Displacement: Third Ventricle	Aqueduct	Fourth Ventricle	Cisternal Filling Defect
I	+	+	+	+	–	–	–	–	–	+	–	–	–	+	Eg Vg	Outlet of third ventricle	+			+
II	+	+	+	+	+	–	–	+	–	+	+	+	–	+	Eg	None	+	+	+	+
III	+	+	+	+	–	–	–	–	–	+	–	–	–	+	Vg	Outlet of third ventricle	+			
IV	+	+	+	+	+	–	–	–	–	+	–	–	–	+	Vg	None	+	+	+	+
V	+	+	+	+	–	–	–	–	–	+	–	–	–	–	Eg	No ventricular filling				+
VI	+	+	+	+	+	+	–	+	+	+	+	–	–	+	None					
VII	+	+	+	+	–	–	–	–	–	+	–	–	–	+	None					

TABLE III: ROENTGENOLOGIC FINDINGS IN 5 PATIENTS WITH VERTEBRAL CHORDOMA

Case	Vertebrae Involved	Osteoblastic Reaction	Osteoclastic Reaction	Pathological Fracture	Intervertebral Disk Involved	Paraspinal Extension of Tumor	Calcific Particles in Paraspinal Tumor	Myelogram
IX	C-3, 4	No	Yes	C-3	C-3/4	Posterior	No	0
X	T-11, 12	No	Yes	T-10, 11	T-10/11	Lateral	No	0
XI	L-2, 3, 4	Yes	Yes	L-2, 3	L-2/3, 3/4	Anterior	Yes	0
XII	L-4, 5	Yes	Yes	L-4	L-4/5	Posterior	No	Obstruction at L-4
XIII	L-5, S-1	No	Yes	L-5	L-5/S-1	Anterior, Posterior and Lateral	Yes	Obstruction at L-5

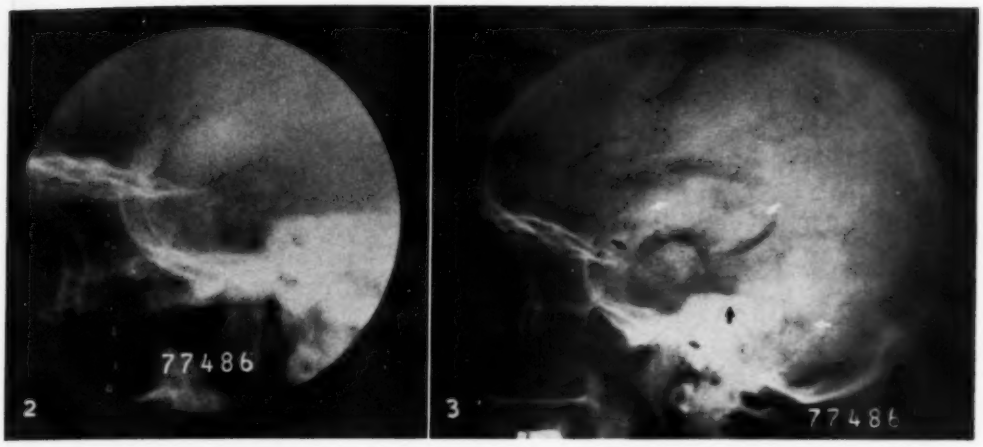

Fig. 2. Case II: Calcified chordoma of the clivus. Osteolysis of the clivus, dorsum sellae, posterior clinoid processes, floor of the sella turcica, and the tuberculum sellae is demonstrated in the plain skull roentgenogram. The tumor invades the ethmoid sinuses, sphenoid sinuses, and nasopharynx, with destruction of the pterygoid processes. A large number of calcium shadows are visible in the intracranial portion of the tumor.

Fig. 3. Case II: Encephalographic appearance of clivus chordoma. The upright lateral pneumoencephalogram was made after the displacement of 50 c.c. of cerebrospinal fluid by oxygen. The ventricles filled with gas without delay, and there is no dilation of the ventricular system. The floor of the third ventricle is elevated and the hypothalamic portion does not fill with gas (left white arrow). The cerebral aqueduct (middle white arrow) and fourth ventricle (right white arrow) are displaced backward 1 cm. from the usual position. The intracranial margin of the tumor is clearly outlined by gas in the narrowed cisterna chiasmatis (left black arrow), interpeduncularis, and pontis (right black arrow).

Fig. 4. Case III: Ventriculographic appearance of clivus chordoma. The ventriculogram was made after the removal of 400 c.c. of fluid from the lateral ventricles and the injection of 385 c.c. of oxygen. The lateral and third ventricles are markedly dilated as a result of complete obstruction of the ventricular pathway at the outlet of the third ventricle (arrow). The floor of the third ventricle is elevated, especially in the posterior portion. Osteolysis of the basisphenoid is conspicuous and intracranial calcium shadows, both punctate and curvilinear, are visible beneath the displaced third ventricle.

Fig. 5. Case X: Vertebral chordoma at T-10. The body and vertebral arch of T-10 are involved by an osteolytic process which is principally on the left side. A slight compression deformity of the vertebral body is evident. Discontinuity of the bone cortex is visible on the lateral aspect of the vertebra and a paraspinal soft-tissue mass is present (arrows). Subsequent radiographs revealed narrowing of the T-10/11 intervertebral space and extension of the tumor to T-11.

eated by gas in the cisterna pontis, interpeduncularis and chiasmatis (Fig. 3). The dome of the mass was retrosellar in position in each instance.

All five chordomas of the vertebral column involved two or more adjacent vertebrae (Fig. 6). The tumor extended from the segment of origin to an adjoining vertebra by growth through the intervening intervertebral disk in each case (Table III). The primary roentgenologic change resulting from vertebral invasion was bone destruction. The final stage of the process always was compression fracture. Osteoblastic reaction in the vertebral bodies was outstanding in 2 cases (Fig. 7). Expansion of a vertebral body and its transverse process was a demonstrable feature in 1 instance (Fig. 6).

The tumor did not remain confined to the vertebral column in any patient but extended into the adjacent soft tissues. In 2 instances, roentgenologically demonstrable discontinuity of the bony cortex was posterior (Fig. 7) and a soft-tissue tumor was not visible in the roentgenograms. In 1 instance, the tumor extended anteriorly (Fig. 6); in another, lateral extension was observed (Fig. 5); and in a third patient the tumor spread forward, backward, and laterally.

Myelography was performed in 2 of the 3 cases in which the tumor extended posteriorly into the vertebral canal. Complete obstruction to the flow of the opaque medium was found. The subarachnoid oil column tapered gradually to the point of obstruction in the manner usually seen with epidural masses compressing the dural sac.

The sacral tumors comprised the smallest group in the series, except for the single example of ventral cranial chordoma found in the nasopharynx. The outstanding roentgenologic finding was osteolysis in one or several segments from the upper sacrum to the coccyx. A soft-tissue mass adjacent to the area of bone destruction was demonstrable radiologically in 2 of the 3 cases (Fig. 8). In each of the tumors calcification or fragmented bone was visible.

TREATMENT AND PROGNOSIS

The treatment of chordomas by either surgery or irradiation is unsatisfactory. Complete surgical excision is usually impossible because of the inaccessible location of the tumor and the close relationship to contiguous vital structures. Surgery undoubtedly has prolonged the lives of patients by subtotal removal of large intracranial growths and by relieving spinal cord compression due to vertebral tumors.

Radiotherapy has been considered to be of little or no value by Hass (8), Ridpath (15), and others. A more general belief however, is that a favorable response can be expected in a small percentage of cases, with gratifying palliative results. An unusually radiosensitive clivus chordoma was reported by Andrews (1). In the group studied here, an adult with a clivus

Fig. 6. Case XI: Vertebral chordoma of L-2, 3, and 4. The bodies of L-2, 3, and 4 are involved by mixed osteoclastic and osteoblastic processes. Lateral (A) and anterior (B) compression deformities of L-2 and L-3 are present. Portions of the vertebral arch of L-3, especially the right transverse process, are involved. The transverse process of L-3 and the anterior portion of the body of L-4 appear expanded, which suggests a slowly growing tumor, although the bone cortex is eroded. A large anterior paraspinal soft-tissue mass is visible in the original roentgenograms.

chordoma (Case IV) has survived without symptoms for more than nine years following biopsy and external irradiation estimated to total 8,000 r to the tumor. The treatment was given in eight series, averaging 1,000 r each, repeated at intervals over a total period of nine years. A striking degree of tumor radiosensitivity was encountered in an 11-year old boy with a large nasopharyngeal chordoma (Case VIII). Almost complete regression of the tumor occurred following an estimated tumor dose of 2,300 r, with relief of nasal obstruction and disappearance of cranial nerve paralyses. Montgomery and Wolman (13) stated that in children chordomas are apt to exhibit a higher degree of radiosensitivity than in adults.

The ultimate prognosis for patients with chordoma is poor. It is highly doubtful whether any case has been cured permanently. A five-year survival is no criterion of cure, since many of the tumors are of slow growth, with late metastasis. The average survival of the 10 patients in the group studied who were followed until death was 3.5 years.

COMMENT

Since the major portion of the material was drawn from the Neurological Institute, it is not surprising that cranial and vertebral chordomas form an extraordinarily high proportion of the tumors in the series. A rare opportunity to compare the roentgenograms of a number of cases of each type was afforded. The study disclosed several roentgen findings of value which have not been emphasized previously.

In the past, calcification has been

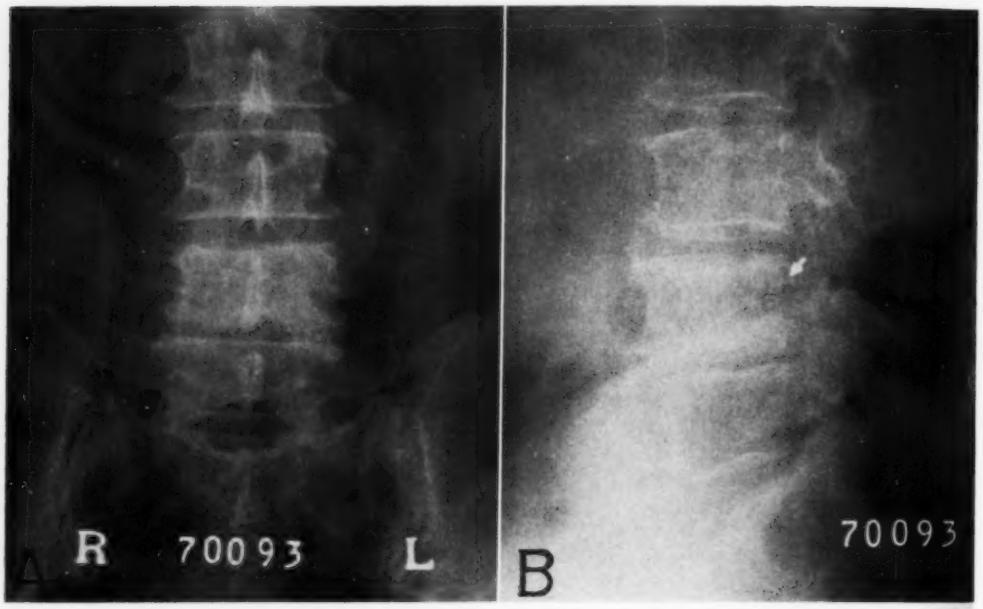

Fig. 7. Case XII: Vertebral chordoma of L-4 and L-5. A striking osteoblastic reaction is present in the body of L-4. Numerous small osteolytic areas also are visible within the vertebra. The L-4/5 intervertebral disk space is thin, and extension of the disease into the superior portion of L-5 is evident. Posteriorly (B), discontinuity of the cortical margin of L-4 is demonstrated (arrow), which suggests extension of the tumor into the vertebral canal. The presence of a tumor in the epidural space was demonstrated by myelography.

thought to be rare. It has been considered suggestive of a lesion other than chordoma, such as craniopharyngioma, pituitary adenoma, or aneurysm. A most conspicuous finding in our cases is the frequent occurrence of calcium shadows in the intracranial tumors.

Moderate enlargement of the sella turcica has been described as a typical feature of chordoma. It is our belief that the sella turcica may appear enlarged only because the dorsum sellae and sellar floor are ill-defined as a result of invasion by tumor. Osteolysis of the posterior and inferior walls of the pituitary fossa was so extensive in 2 of the 7 clivus chordoma cases that measurements could not be made. In the 5 cases in which either the length or depth of the sella turcica could be determined accurately, the measurement exceeded the maximum by 1.0 mm. in only one patient, in whom increased intracranial pressure occurred (Fig. 4). Dyke (4) described displacement of the pineal shadow in 2 cases of chordoma among a group of 3,000 skull films surveyed at the Peter Bent Brigham Hospital (Boston), but pineal displacement was not observed in the 4 patients having visible pineal glands in the present study.

Pneumoencephalograms and ventriculograms are helpful in demonstrating the retrosellar position of the tumor. Tumors arising in the hypophyseal region usually do not extend infratentorially. The position and contour of the intracranial portion of the tumor are demonstrated by gas in the narrowed subarachnoid cisterns. The floor of the third ventricle usually is displaced upward, while the aqueduct of Sylvius and fourth ventricle are displaced backward.

The pons and medulla oblongata, displaced backward by the tumor, often are demonstrated between gas shadows in the narrowed cisterna pontis and the fourth ventricle (Fig. 3). Obstruction to the circulation of cerebrospinal fluid may result from compression of the midbrain at the incisura of the tentorium (Fig. 4).

It is of interest that the vertebral chordomas may be found at any vertebral level and extend into the soft tissues on any side of the vertebral column. Involvement of adjacent vertebrae and the intervertebral disks is of diagnostic importance. It is possible at the initial examination to misinterpret the changes as the result of tuberculosis or pyogenic osteomyelitis because the intervertebral disk space is narrowed.

A noteworthy finding is an osteoblastic reaction in the vertebral bodies in 2 of the 5 patients. A mistaken diagnosis of metastatic carcinoma, Hodgkin's disease, lymphosarcoma, leukemia, myeloma, hemangioma, or osteitis deformans may be made. When the lesion is confined to one vertebral segment during the early stage of the disease, bone expansion may suggest benign giant-cell tumor. Myelography is valuable to determine the limit of epidural extension of the tumor when surgical decompression is to be performed.

Fig. 8. Case XVI: Sacrococcygeal chordoma. The lower three sacral segments and the coccygeal segments are partially destroyed. The principal osteolysis is central. A soft-tissue mass is visible in the pelvis, superimposed upon the sacrum in the roentgenogram (arrows). Numerous calcific particles are visible within the tumor. A barium enema disclosed forward displacement of the rectum and sigmoid.

SUMMARY

1. A roentgen study of 16 proved cases of chordoma is presented.

2. Chordomas of the clivus cause destruction of the sphenoid bone in the great majority of cases. The tumor commonly extends into the sphenoid sinuses, often into the nasopharynx, and occasionally into the ethmoid region.

3. In the intracranial tumors, calcific particles are frequently demonstrable roentgenologically.

4. Encephalography and ventriculography are valuable procedures for establishing the diagnosis of chordoma. The third ventricle usually is displaced upward, while the cerebral aqueduct and fourth ventricle are displaced backward. The tumor is outlined discretely by gas in the subarachnoid cisterns.

5. Vertebral chordomas characteristically produce osteolysis of two or more vertebrae and invade the intervening intervertebral disks. Extra-osseous extension of the tumor occurs in any direction.

6. Osteoblastic reaction may be encountered in the vertebral column associated with bone destruction. Whenever a mixed osteoclastic and osteoblastic reaction is observed, the diagnosis of chordoma must be considered.

7. Biopsy verification of the clinical or roentgen diagnosis is desirable. Conservative surgical excision and external irradiation are procedures usually employed in treatment. A favorable response to roentgen therapy can be expected in a small percentage of cases, with gratifying palliative results.

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SUMARIO

Cordomas: Estudio Roentgenológico de Dieciséis Casos Inéditos

Este estudio roentgenológico versa sobre 16 casos comprobados de cordoma.

Los cordomas clivosos ocasionan destrucción del esfenoides en la gran mayoría de los casos. El tumor se extiende habitualmente a los senos esfenoidales, a menudo a la nasofaringe y a veces a la región etmoidal.

En los tumores intracraneales hay con frecuencia partículas calcificadas observables roentgenológicamente.

La encefalografía y la ventriculografía constituyen procedimientos valiosos para establecer el diagnóstico de cordoma. El tercer ventrículo suele estar desplazado hacia arriba, mientras que el acueducto de Silvio y el cuarto ventrículo están desplazados hacia atrás. El tumor queda demarcado discretamente por gas presente en las cisternas subaracnoideas.

Los cordomas vertebrales provocan característicamente osteólisis de dos o más vértebras e invaden los discos intervertebrales interpuestos. Difusión extraósea del tumor ocurre en cualquier dirección.

Asociada a la osteólisis puede observarse reacción osteoblástica en la columna vertebral. Siempre que se descubra reacción osteoclástica y osteoblástica mixta, hay que considerar el diagnóstico de cordoma.

La comprobación biópsica del diagnóstico clínico o roentgenológico resulta conveniente. La excisión quirúrgica conservadora y la irradiación externa son los procedimientos empleados habitualmente en el tratamiento. Cabe esperar respuesta favorable a la roentgenoterapia en un pequeño porcentaje de los casos, con resultados paliativos halagueños.

Mobility of the Rectosigmoid

A New Diagnostic Sign[1]

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WHILE THE RECTOSIGMOID is one of the most frequent sites of disease of the alimentary tract, it is the most difficult to examine roentgenographically. Newer technics (1) have been of considerable assistance in revealing the anatomy of the rectum as well as various pathological conditions not shown by routine methods. Any additional light that can be thrown on the presence or extent of disease in this region should be helpful to both the roentgenologist and the surgeon. It is unfortunate that lateral roentgenograms of the colon before and after evacuation of a barium enema are too infrequently employed, for in our experience they have often given more information than could be obtained from the postero-anterior films.

The sigmoid colon begins at the pelvic brim as a continuation of the descending colon and ends at its junction with the rectum at the level of the third sacral vertebra. The rectum extends from the third sacral vertebra to the pelvic diaphragm, where it becomes continuous with the anal canal.

The sigmoid is suspended by its mesentery, one end of which is attached to the left side and posterior surface of the sigmoid and upper rectal ampulla, and the other to the left side and front of the prevertebral fascia. Cunningham (2) states that "the sigmoid mesentery (or pelvic mesocolon) is a fan-shaped fold in the form of an inverted V and is shorter in its middle portion than at its lateral extremities. Its root is attached along an inverted V-shaped line, one limb of which runs close to the medial border of the left psoas major muscle as high as the bifurcation of the common iliac artery; there, it bends at an acute angle and the second limb bends over the front of the sacrum to the middle of the third piece, where the mesentery ceases. When the pelvic colon ascends into the abdomen proper, the mesentery is doubled upon itself, the side which was naturally posterior becoming anterior." From this description, it may be seen that the sigmoid mesentery is redundant to allow for varying degrees of distention and pressure within the related segment of the large bowel.

The rectum is suspended between two points—the upper being its continuity with the sigmoid; the lower, the pelvic diaphragm. The lower attachment of the rectum is securely fixed by the levator ani muscle, some fibers of which blend with the intrinsic musculature of the rectum. The upper attachment is a movable point. Posteriorly, the rectum is in contact with fibro-areolar and fatty tissue which acts as a cushion between the bowel and the bony pelvis. Anteriorly, the rectum is separated by similar tissue from the vagina and urethra in the female and the prostate and urethra in the male. The fine dissections of Curtis, Anson, and Beaton (3) have shown that "of the three pelvic organs, the rectum is the least firmly fixed to its peritoneal covering, a clear separation being easily effected between the latter and the rectal collar of the endopelvic fascia .... Except for its peritoneal investment and the hemorrhoidal vessels, the rectum, in so far as observed in the present study, is without special ligamentous support."

It becomes apparent that the support of the rectosigmoid is designed to allow some

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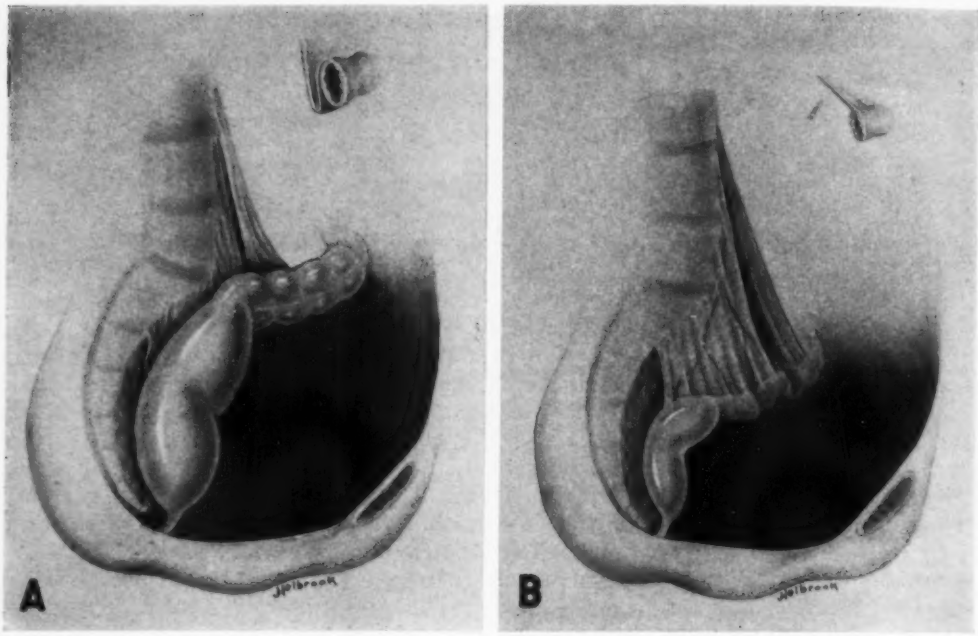

Fig. 1. Semidiagrammatic illustration of the rectosigmoid with the patient in left lateral decubitus. A. Position of the rectum and sigmoid before evacuation. Due to the backward and upward movement of this loop, the mesentery hangs in loose folds in the pelvis. It appears as an inverted "V," one limb of which attaches to the upper rectal ampulla and lower sigmoid, and the other limb to the remainder of the sigmoid. B. Position of the empty colon. The sigmoid drops into the pelvis, the degree of movement depending on the length of the mesentery; the upper rectal ampulla falls away from the sacrum.

mobility of this segment. The degree of mobility is normally dependent upon the length of the mesentery, which is subject to considerable variation. When viewed in the lateral position, the rectosigmoid forms a loop sharply flexed upon itself. In the postero-anterior position, the evacuated sigmoid lies in the pelvis (Fig. 1).

When the rectosigmoid is distended with barium or with air, the increased hydrostatic pressure causes this loop to uncoil. As a result, these segments rise in the pelvis and are displaced posteriorly, the rectum lying close to the hollow of the sacrum and the lower end of the sigmoid close to the sacral promontory. After evacuation, the upper rectal ampulla and sigmoid fall away from the sacrum. The degree of movement varies according to the length of the mesentery, but normal patients will usually show a definite shift in position of these segments before and after evacuation of an enema. This is best demonstrated in the lateral view (Fig. 2), though the rise and fall of the sigmoid are also well seen in the postero-anterior films.

Failure of the rectosigmoid to shift position before and after evacuation of an enema usually indicates the presence of disease. The lesion may originate in the bowel, in the pelvic viscera, or in the bony pelvis. Thus, the rectosigmoid may be fixed in an anterior position by a presacral tumor or it may be held against the sacrum by a tumor in the anterior pelvis. It may be fixed in any position in the pelvis by pelvic inflammatory or neoplastic disease, or by a lesion which has arisen in the bowel and broken through into the pelvis. Mobility of the rectosigmoid is therefore important as a sign in detecting disease in the pelvis; it has value as a prognostic index and is equally useful to the surgeon in his preoperative evaluation of the extent of disease.

Fig. 2. Normal appearance before and after evacuation of a barium enema. A. Before evacuation. The rectum lies in close proximity to the sacrum due to the hydrostatic pressure of the enema which causes the rectosigmoid to "uncoil" and rise in the pelvis. B. After evacuation. These segments fall away from the sacrum and lie lower in the pelvis In the absence of disease, the degree of movement is determined by the length of the mesentery of the sigmoid.

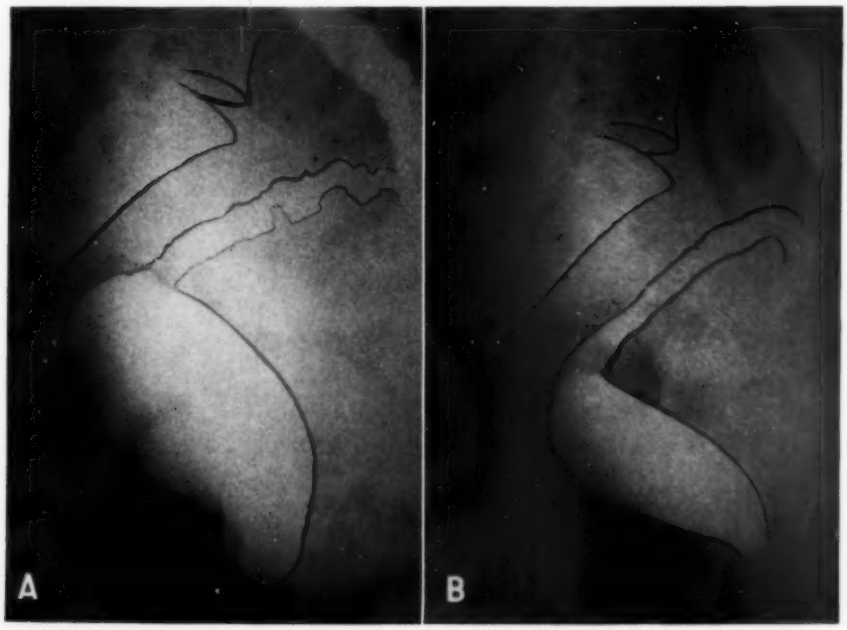

Fig. 3. Case I: Fixation of the rectosigmoid due to extensive adhesions following two pelvic operations. A. Before evacuation. The upper rectal ampulla and lower sigmoid do not lie in their normal position against the sacrum. B. After evacuation. There has been no change in position.

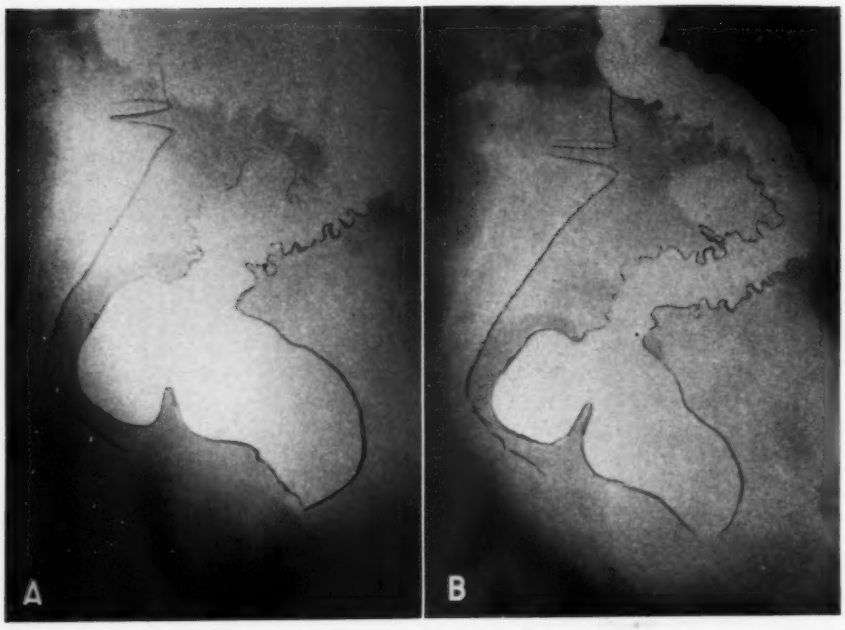

Fig. 4. Case II: Fixation of rectosigmoid following diverticulitis. A. The rectosigmoid fails to reach the sacrum when distended. B. No change in position of the rectosigmoid after evacuation.

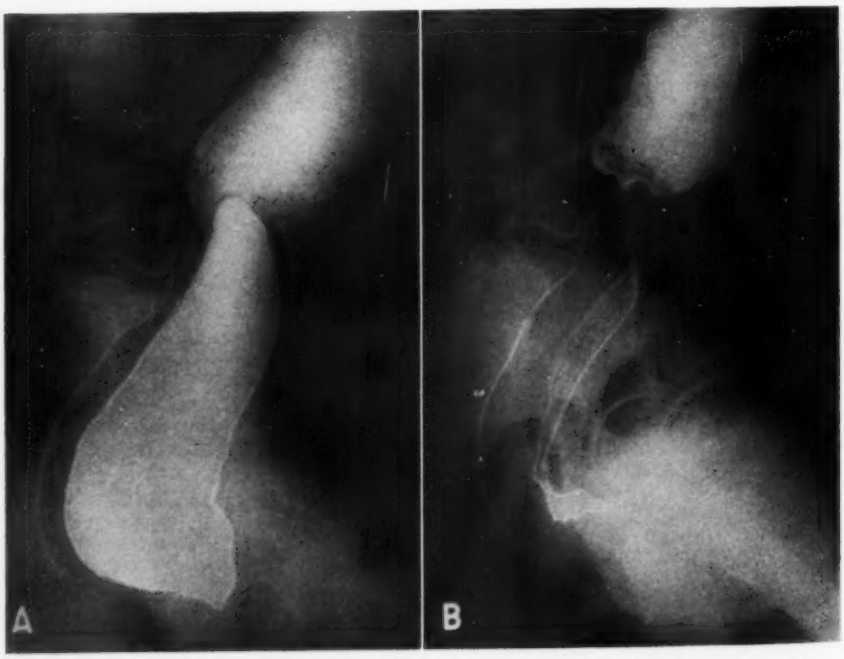

Fig. 5. Case III: Fixation of the rectosigmoid due to volvulus of the sigmoid. A. Before evacuation. The rectosigmoid lies close to the sacrum and spine and is high in the abdomen, due to shortening of the mesentery as a result of torsion. B. After evacuation. The evacuated colon cannot fall away from the spine because its movement is restricted by the shortened mesentery. In volvulus of the sigmoid, the rectosigmoid segment is fixed in a posterior and high position.

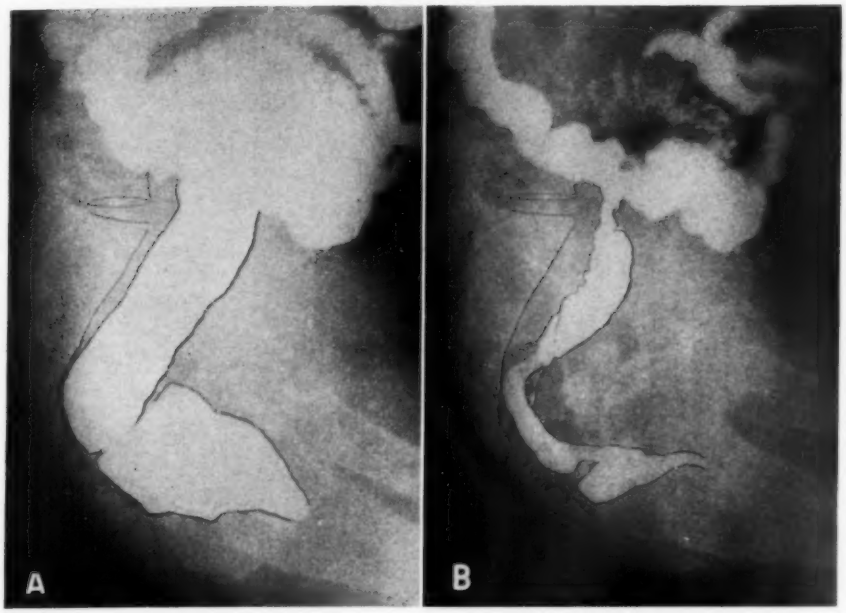

Fig. 6. Case IV: Fixation of the rectosigmoid due to invasion by papillary cystadenocarcinoma of the ovary. A. Before evacuation. The rectosigmoid lies close to the spine. The psammous calcification in the tumor is faintly visible anterior to the sigmoid. B. After evacuation. The rectosigmoid is fixed by direct extension of the tumor.

The following case reports illustrate various types of fixation of the rectosigmoid. Because of the difficulty in reproducing lateral roentgenograms to show both the sacrum and the bowel, all films have been retouched.

CASE I: E. A., female, aged 66, entered the Massachusetts Memorial Hospitals complaining of vaginal bleeding, which was found to be caused by a cervical polyp. She had had an appendectomy forty years and a hysterectomy eighteen years before admission. A barium enema (Fig. 3) showed the rectosigmoid fixed in a somewhat anterior position in the pelvis by adhesions from the previous operations.

CASE II: E. H., female, aged 61, complained of frequency, urgency, diarrhea alternating with constipation, and the occasional passing of bright red blood in the stools. She had had an appendectomy previously, at which time the surgeon noted the presence of numerous diverticula of the sigmoid, and fixation of the bowel by extensive adhesions. She was referred later for a barium enema (Fig. 4). Examination revealed numerous diverticula in the distal colon. The rectosigmoid was fixed.

CASE III: R. W., male, aged 39, entered the hospital with crampy pain in the right upper quadrant, occurring every three to five minutes. There had been several such episodes in the past four years. Physical examination revealed slight distention over the epigastrium and bulging in the right upper quadrant. The rectum was completely empty of fecal material. A barium enema showed volvulus of the sigmoid (Fig. 5), with immobility of the rectosigmoid (with relation to 5th lumbar vertebra) due to shortening of the mesentery as a result of torsion.

CASE IV: T. McC., female, aged 54, complained of a dragging sensation and cramp-like pain in the lower abdomen, and constipation of two months duration. A barium enema (Fig. 6) showed the rectum and lower sigmoid displaced posteriorly by a pelvic mass. (The type of calcification is fairly typical of papillary tumors of the ovary.) Operation revealed a papillary cystadenocarcinoma of the ovary, with invasion of the rectum.

CASE V: A. A., female, aged 67, entered the hospital with a history of constipation of several years duration, which had become worse in the past eight weeks. Recently there had been some diarrhea, vomiting, and loss of weight. A barium enema (Fig. 7) showed extensive malignant disease of the upper rectal ampulla and lower sigmoid. The involved segments were firmly fixed, indicating extension of the lesion to the pelvis. Laparotomy revealed a hard mass involving the lower sigmoid and upper portion of the rectum, with extension into the pararectal tissues.

Fig. 7. Case V: Fixation of the rectosigmoid due to carcinoma of the rectum with extensive invasion of the pelvis. A. Before evacuation. The upper rectal ampulla and sigmoid do not reach the spine. B. After evacuation. There has been no change in position of these segments, indicating extension of the disease through the wall of the bowel. The technical difficulty of surgery and the serious prognosis may be readily inferred.

CASE VI: H. C., female, aged 47, complained of abdominal distention and crampy abdominal pain of two or three months duration. Seven months previously she had experienced pain in the right groin and thigh and was treated elsewhere for pelvic infection. On admission, the pain was almost continuous and quite severe. A barium enema (Fig. 8) showed the rectosigmoid fixed in an anterior position in the pelvis. There was evidence of a mass behind the rectosigmoid, and pressure on the anterior wall of the sigmoid suggested the presence of a mass in front of it. At operation, the pelvis was found to be filled with neoplastic tissue involving the cecum, sigmoid, and genital organs. The primary site was thought to be in the cecum.

CASE VII: W. R., male, aged 73, gave a history of intermittent rectal bleeding for one year. A barium enema showed carcinoma of the hepatic flexure and a single polyp of the upper rectal ampulla (well shown in the post-evacuation film) (Fig. 9). Pathologic examination of the lesion showed it to be a polyp with low-grade superficial malignancy (adenoma malignum). The absence of invasive malignant changes is well demonstrated in this case.

CASE VIII: J. C., female, aged 43, complained of alternating constipation and diarrhea of four months duration. Nine months before admission she had had two applications of radium for carcinoma of the cervix (5,088 mg. hr). Barium enema (Fig. 10) showed a smooth area of narrowing at the rectosigmoid junction. Backward movement of the segment was limited. After evacuation, the loop fell forward in the pelvis, indicating the presence of adhesions to the anterior aspect of the bowel.

CASE IX: J. Y., female, aged 56, entered the hospital, complaining of crampy pain in the right lower quadrant occurring every two to five days, relieved by bowel movements; there was a history, also, of vomiting and loss of weight. Six months previously, a gastro-intestinal examination showed a tumor of the jejunum (adenocarcinoma). On the present admission, a barium enema (Fig. 11) showed the rectum and sigmoid pushed against the spine by a large mass in the anterior pelvis (Krukenberg tumors of both ovaries). There was no actual invasion of the bowel.

SUMMARY

The anatomical support of the rectosigmoid is such as to allow a degree of movement of these segments of the large intestine. Mobility is well demonstrated

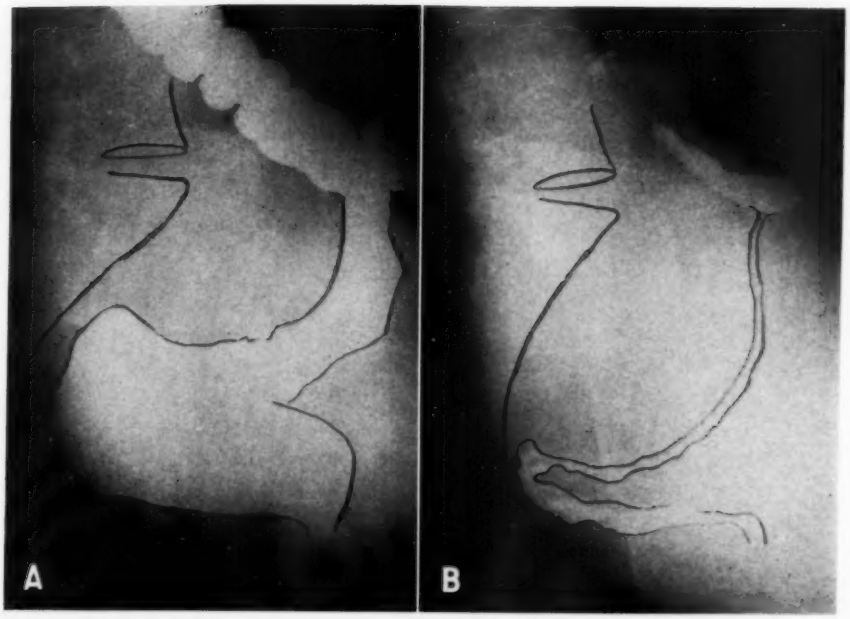

Fig. 8. Case VI: Fixation of the rectosigmoid due to carcinoma of the pelvic viscera (primary site probably in the cecum). A. Before evacuation. The upper rectal ampulla and lower sigmoid do not reach the spine. B. After evacuation. There has been no change in position of the segments.

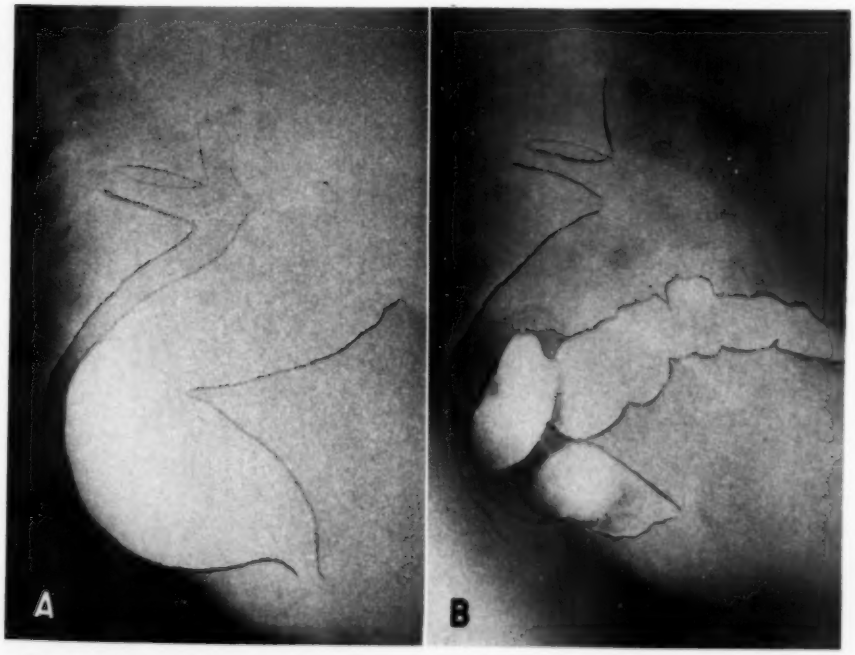

Fig. 9. Case VII: Normal mobility of rectosigmoid in a case of rectal polyp with early malignant change (adenoma malignum). A. Before evacuation. The rectosigmoid assumes its normal position after distention. B. After evacuation. The rectosigmoid has fallen away from the spine, indicating that the lesion has not broken through the bowel.

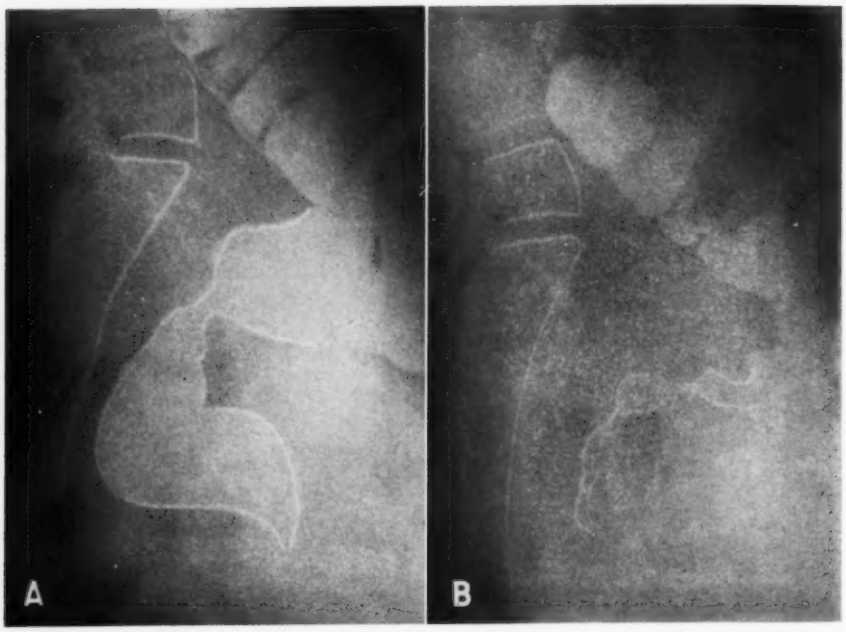

Fig. 10. Case VIII: Partial fixation of the rectosigmoid due to radiation fibrosis. A. Before evacuation. The upper rectal ampulla is stenosed and its backward movement toward the sacrum is restricted by adhesions to its anterior wall. B. After evacuation. The rectosigmoid assumes the position in the pelvis which is normal for an evacuated bowel. The cause of low pelvic pain when the colon is distended may be explained by this mechanism.

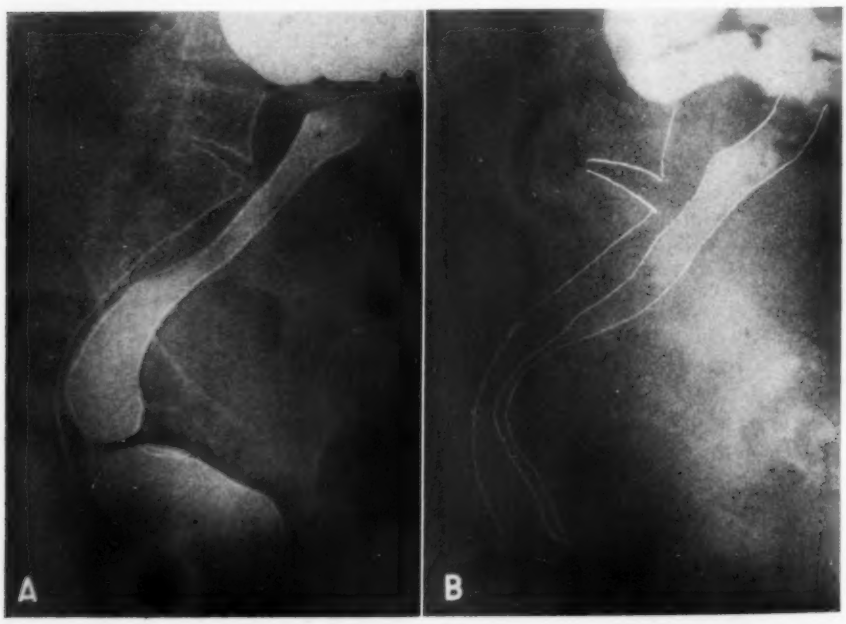

Fig. 11. Case IX: Fixation of rectosigmoid by pelvic tumor without invasion of the bowel (Krukenberg tumor of the ovaries). A. Before evacuation. The rectosigmoid shows a pressure defect on the anterior wall produced by the tumor, which displaces the bowel posteriorly and upward. B. After evacuation. The rectosigmoid does not fall away from the spine.

in lateral roentgenograms taken before and after evacuation of a barium enema. Normally, in a distended bowel, the rectum lies close to the hollow of the sacrum and the rectosigmoid junction is close to the sacral promontory. After evacuation of an enema, the upper rectal ampulla and sigmoid fall away from the spine. Failure of these segments to move is usually an indication of disease in the pelvis, which may originate in the colon or other pelvic viscera. Restricted mobility of the rectosigmoid is thus a useful roentgenologic sign which contributes to the diagnosis of disease in the pelvis. It also helps to define the extent of a carcinoma of the rectum or sigmoid.

Fixation of the rectosigmoid in various types of pelvic disease is illustrated by brief case histories.

NOTE: We are indebted to Miss Jane Holbrook, staff artist of the Massachusetts Memorial Hospitals, for the drawings and photography.

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SUMARIO

La Limitación de la Movilidad del Rectosigmoides: Nuevo Signo Diacrítico

El apoyo anatómico de la porción rectosigmoidea del intestino grueso es tal que permite cierto movimiento a esos segmentos. Es fácil observar esa movilidad en las radiografías laterales tomadas antes y después de la evacuación de un enema de bario. Normalmente, si el intestino se halla distendido, el recto queda junto al hueco del sacro, y la unión rectosigmoidea junto al promontorio del sacro. Después de la evacuación de un enema, la porción superior de la ampolla rectal y la S ilíaca se alejan del raquis. La inmovilidad de esos segmentos suele ser indicación de enfermedad en la pelvis, que tiene su origen en el colon o en otras vísceras pelvianas. La restricción de la movilidad del rectosigmoides resulta, pues, un útil signo roentgenológico que ayuda en el diagnóstico de afección pelviana, y también a definir la extensión de un carcinoma del recto o de la S ilíaca.

Preséntanse varias breves historias clínicas, demostrando la fijación rectosigmoidea en varias formas de enfermedad pelviana, tales como adherencias postoperatorias, vólvulo de la S ilíaca con acortamiento del mesenterio debido a torsión, adenoma quístico del ovario con invasión del recto, neoplasias malignas de la porción inferior del tubo digestivo, fibrosis por irradiación y tumores de Krukenberg en los ovarios.

Hepato-Diaphragmatic Interposition of the Small Intestine[1]

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THE PRESENCE OF gas between the liver and the diaphragm poses the differential diagnosis of pneumoperitoneum from a perforated viscus, subdiaphragmatic abscess, and intestinal hepato-diaphragmatic interposition. Colonic hepato-diaphragmatic interposition has been frequently reported. Small intestinal hepato-diaphragmatic interposition, on the other hand, has previously been described but once, when it was recognized postmortem (2). In that case, a scout film made before the patient's death showed the condition but was misinterpreted as indicating a perforated viscus, whereas it actually represented an internal hernia through an opening in the falciform ligament, with obstruction of herniated small bowel loops interposed between liver and diaphragm.

The rarity of reports of small intestinal hepato-diaphragmatic interposition is surprising when one considers the large number of reports of colonic interposition, particularly in view of the greater mobility of the small bowel. It seems possible that in many of the reported cases of colonic hepato-diaphragmatic interposition it was actually the small intestine that was interposed, for unless a barium enema study was performed, proof that the bowel was actually colon is lacking. The gas-distended ileum can simulate the large bowel (7), and what appear to be haustral indentations may actually be valvulae conniventes (see Fig. 1).

As is the case with colonic hepato-diaphragmatic interposition, the diagnosis of small-intestinal interposition is essentially roentgenologic. Gas-filled loops of intestine between the diaphragm and the liver, demonstrated on either recumbent or upright abdominal films, or on a chest film, must be further studied with the barium enema. If it is the colon which is interposed the barium will enter the gas-filled loops. If, however, the entire colon is filled with barium and none is seen in the interposed loops, the diagnosis is interposition of the small intestine, as in the case to be reported here.

The etiology of colonic interposition has been discussed in most of the papers on the subject. Bockus (1) lists the causes as submitted by Choussat and Choussat-Clausse:

1. Intestinal factors.
   (*a*) Megacolon or abnormal accumulation of gas in the intestinal tract, causing upward displacement of the diaphragm.
   (*b*) Abnormal mobility of the colon of congenital origin.
2. Diaphragmatic factors.
   (*a*) Abnormally high diaphragm due to thinning of musculature or to musculature degeneration.
   (*b*) Phrenic nerve injury or disease, with paralysis of the diaphragm.
   (*c*) Changes in intrathoracic pressure, as in tuberculosis, empyema, etc.
3. Hepatic factors.
   (*a*) Ptosis of the liver.
   (*b*) Small liver.
   (*c*) Relaxation of the suspensory ligament.
   (*d*) Fixation of the liver due to adhesions associated with traction produced by the gastrohepatic ligament or perigastritis.

One or a combination of factors may be active in the production of the condition. Most of these same factors can no doubt be operative in the causation of small bowel interposition. Gaster's case (2) of small intestinal hepato-diaphragmatic interposition, cited above, was caused by an internal hernia through an aperture in the falciform ligament, with a strangulated closed gas-filled loop of small intestine lying between the diaphragm and liver.

Two types of interposition occur, the transient (or sliding) and the persistent (most cases).

The symptoms of interposition of either colon or small intestine are difficult of

[1] Accepted for publication in May 1949.

evaluation. It is likely that the condition occurs without symptoms, and that this is true of most cases (see Fig. 1). When intra-abdominal or thoracic symptoms are present, they are probably due to primary (possibly undiscovered) disease or diseases for which the patient is being investigated by the roentgenologist. Symptoms are frequently described, however, in case reports of colonic interposition. Schenck (5) believes these patients may have localized

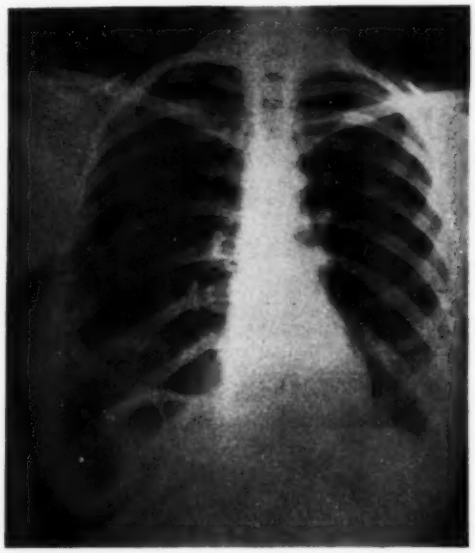

Fig. 1. Chest roentgenogram of an asymptomatic healthy female in which interposition of intestine between liver and diaphragm was incidentally discovered. A barium enema would be necessary to determine definitely whether the interposed intestine is small or large, even though haustrations are apparently present.

or generalized abdominal pain aggravated by deep inspiration and sometimes radiating to the right shoulder. He states, also, that abdominal distention and constipation are often present. Starr (6) reported a case of colonic interposition in which he attributed some obstruction in the duodenum and stomach to the displaced liver.

It is important that hepato-diaphragmatic interposition, whether it be of the small or large intestine, be recognized and not mistaken for free air under the diaphragm (2, 4), as from a perforated viscus, or encapsulated gas from a subphrenic

Fig. 2. Four-hour follow-up film of authors' case, showing the presence of gas-filled loops of bowel interposed between liver and diaphragm.

abscess. It is of even greater importance that one appreciate that two conditions can exist in the same case, and that a perforated viscus is not ruled out merely because interposition is present (3). The finding may be very significant, as in Gaster's case (2), where it represented a strangulated internal hernia of small intestine.

CASE REPORT

J. G., white male, age 70, complained of left upper abdominal pain radiating into the back, present for about three years. The pain appeared fifteen to twenty minutes after eating and was relieved by alkalis. There was a history, also, of moderate weight loss and constipation.

Physical examination revealed a poor state of nutrition and epigastric tenderness. There were no other noteworthy abnormalities.

Roentgen examination showed a gastric ulcer high on the lesser curvature of the stomach. Interposition of the small intestine between the liver and the diaphragm was discovered incidentally (Figs. 2 and 3) when a collection of gas under the right diaphragm was investigated.

The patient responded to a peptic ulcer regime, but symptoms recurred when he departed from the ulcer program.

(Death occurred about one year after the above

Fig. 3. Barium enema study showing the interposed gas-filled loops to be small and not large intestine.

investigation. The cause was presumed to be coronary thrombosis, but no autopsy was performed.)

SUMMARY

1. A case of interposition of the small intestine between the liver and diaphragm is reported.

2. Colonic hepato-diaphragmatic interposition can be differentiated positively from small intestine interposition only by a barium enema.

3. It is probable that most cases of interposition, whether of small intestine or large, are not symptomatic, *per se*.

4. It is important not to mistake hepato-diaphragmatic interposition for a perforated abdominal viscus or subphrenic abscess, and to realize that it can coexist with either of these conditions. It may also represent an internal hernia of small intestine.

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SUMARIO

Interposición Hepato-Diafragmática del Intestino Delgado

El caso presentado es de interposición del intestino delgado entre el hígado y el diafragma.

La interposición hepato-diafragmática del colon puede diferenciarse positivamente de la del intestino delgado sólo con un enema de bario.

Es probable que la mayor parte de los casos de interposición, ya del intestino delgado o del gueso, no sean, en sí mismos, sintomáticos.

Resulta importante no confundir la interposición hepato-diafragmática con la perforación de una víscera abdominal o absceso subfrénico, y comprender que puede coexistir con uno u otro de esos estados. Puede también representar una hernia interna del intestino delgado.

Multiple Carcinomas of the Large Bowel[1]

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New York, N. Y.

MULTIPLE carcinomas of the colon are not uncommon. Sheinfeld recently reviewed the reports of Abell, Cokkinis, Brindley, and Berson and found 30 cases of multiple lesions in 835 cases of carcinoma of the colon and rectum, an incidence of 3.5 per cent. Although our experience would indicate that this figure is quite high, one should keep in mind the possibility of multiple carcinomas when performing a barium enema examination. The following is a report of five carcinomas of the large bowel in one patient. It is noteworthy that there was no evidence of congenital or multiple polyposis.

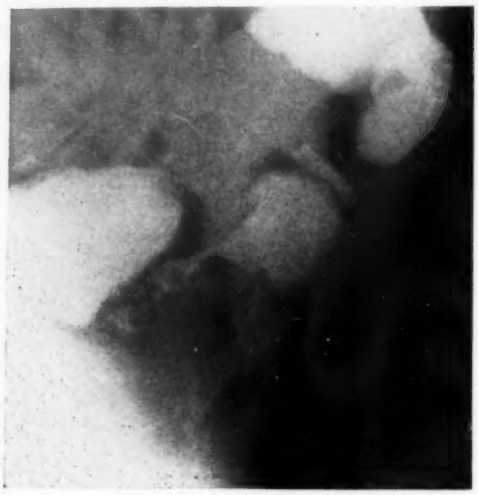

Fig. 1. Large irregular constricting lesion of the sigmoid, with destruction of mucous membrane and overhanging margins. *Impression:* Carcinoma of the sigmoid.

R. C., a white woman, age 42 years, was examined at the office on May 3, 1946. She gave a history of diarrhea developing six years earlier and of alternating diarrhea and constipation since that time. One year before the initial office examination, postprandial cramps occurred, with no relief. Two months prior to the examination she noticed bright red blood in the stool. At that time a barium enema examination performed at another hospital revealed no evidence of a lesion.

Fig. 2. Small punched-out filling defect on the medial wall of the bowel. *Impression:* Whether this represents a benign or a malignant lesion cannot be determined.

The patient appeared fairly well developed and not acutely ill. The entire physical examination was negative except for a mass the size of an orange in the epigastrium. A smaller mass was noted in the left lower quadrant. Both were tender and fairly movable.

The white blood count was 14,800, with 73 per cent polymorphonuclears and 20 per cent lymphocytes. The red blood count was 3,940,000 with a hemoglobin of 70 per cent. The urine was normal.

Barium enema examination revealed a fairly large, irregular, constricting lesion in the sigmoid. The mucous membrane in this area was destroyed and the margins of the lesion were overhanging. Several centimeters above this, a small, punched-out, fairly smooth filling defect was noted on the medial wall of the bowel. Two additional constricting lesions were seen: one in the proximal descending colon, and the other in the distal transverse colon. The mucous membrane in both these areas was destroyed and the appearance was that usually seen with carcinomas of the large bowel. Fluoroscopically, still another constricting lesion was discovered in the ascending colon, though this was not adequately demonstrated on the films. The impression was multiple carcinomas of the large bowel. The small filling defect

[1] Accepted for publication in June 1949.

Fig. 3. Constricting lesion in the proximal descending colon and distal transverse colon. *Impression:* Carcinoma.

in the sigmoid was interpreted as representing a polyp and no statement could be made as to whether it was benign or malignant.

Operation was performed and the large bowel was resected from hepatic flexure to sigmoid. There was no evidence at this time of any metastases in the lymph nodes, liver, or peritoneum. The postoperative course was uneventful.

Pathology Report: The dissected bowel measured 60 cm. in length. The distal end contained a firm, ulcerated tumor about 4 cm. in diameter with elevated papillary edges. Three other large carcinomas of similar appearance were found, including a lesion in the ascending colon which was seen fluoroscopically but not on the films. The small polyp in the lower descending colon was malignant. There was no evidence of any benign polyps.

Diagnosis: Multiple carcinomas (five) of the large bowel. The patient was well for five months, and a mass then appeared in the right upper quadrant. A barium-enema examination revealed no evidence of any recurrent lesion within the remaining portion of large bowel. The patient was re-explored and a lobulated, metastatic carcinomatous mass involving the edge of the right lobe of the liver, about the size of an orange, was found. Microscopic examination revealed metastatic carcinoma.

SUMMARY

1. Multiple colonic lesions are not uncommon, and this possibility should always be considered in the course of a barium-enema examination.

Fig. 4. Constricting lesion in distal transverse colon. The mucous membrane pattern is destroyed. The margins are overhanging. *Impression:* Carcinoma.

2. A case in which 5 carcinomas of the large bowel were demonstrated radiologically and subsequently proved at operation is presented.

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SUMARIO

Carcinomas Múltiples del Intestino Grueso

Las lesiones colónicas múltiples no tienen nada de raras, posibilidad esta que hay que considerar siempre al ejecutar algún estudio con enema de bario.

Comunícase un caso en el que se descubrieron radiológicamente cinco carcinomas del colon, comprobados al operar. El intestino fué resecado desde la flexura hepática hasta la S ilíaca, pero cinco meses después apareció una tumefacción en el hipocondrio derecho y la exploración reveló metástasis carcinomatosas en el hígado.

A Device for Roentgen Examination of the Colon Following Colostomy[1]

JOSEPH C. ROOT, M.D., and ALBERT A. RAYLE, JR., M.D.
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ONLY TWO METHODS for roentgen examination of the colon following colostomy have been found in the literature. One of these, that of Pendergrass and Cooper (1), adapted only to visualization of the distal segment in a loop colostomy, makes use of a rubber bulb, of the proper size, from an Asepto syringe. This bulb serves to occlude the colostomy stoma for sigmoidoscopy and roentgen examination following wounds of the large bowel, but is not designed for injection of a barium mixture through the colostomy. The neck of the bulb is inserted in the colostomy opening and the bulb is firmly strapped to the abdominal wall with adhesive tape. The distal loop is then filled with barium per rectum.

A modification of this procedure was advanced by Robin (2). In this procedure, the neck of the bulb is tapered in order that it may better fit the colostomy opening, and the bulb is strapped in place as before. A 15-gauge needle is then inserted through the bulb and connected to the barium supply with the usual tubing. With a "Y" connection and proper clamping, two such bulbs can be strapped in place and used for successively examining the distal and proximal segments in a loop colostomy. Another method, which we have employed in the past, uses a soft rubber ball through which an enema tip has been inserted.

Postoperative barium-enema examination is important in all patients on whom colostomy has been done, and imperative in many. The primary purpose is to determine whether any additional lesion has developed or if there is any recurrence of neoplastic disease in the portion of the colon which remains after abdominoperineal resection for cancer. We have also encountered cases in which loop colostomy was performed to divert the fecal stream from areas of diverticulitis or ulcerative colitis in the distal colon or rectum. In this event adequate filling and visualization are important, since, if the lumen can be shown to be adequate and the inflammatory process quiescent, continuity of the bowel can be effected and may prove permanent.

With methods heretofore used, examinations of the colon following colostomy have been difficult and unpleasant. The results frequently have been unreliable, due to inability to fill the remaining segment of colon, while visualization has often been limited because of leakage of the barium mixture from the colostomy opening at the time of filling. A method, therefore, which eliminates leakage and permits adequate filling of the colon should be of great benefit both to the patient and the roentgenologist.

For the past seven years we have used the device pictured in Figure 1, which was made in our machine shop. A 4.0-cm. hole was made in the center of a block of bakelite measuring 7.5 × 3.0 cm. The resulting doughnut-shaped piece of bakelite was hollowed from its bottom surface to a depth of 1 cm., leaving suitable walls. At this depth, a 4 × 3-mm. circular groove was inscribed in the floor of the hollowed portion. A 5-mm. hole was drilled at right angles to this groove to act as a small air reservoir and to prevent the vacuum outlet from becoming plugged. This hole could probably be extended through to the top of the device with equally good results. It was felt, however, that a better distribution of the vacuum might be obtained

[1] From the Cleveland Clinic and the Frank E. Bunts Educational Institute. Accepted for publication in June 1949.

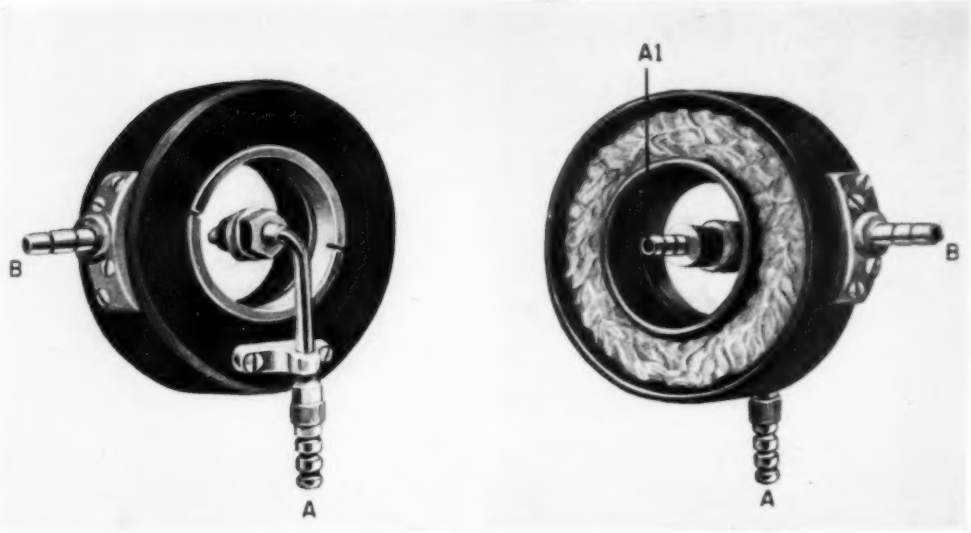

Fig. 1. Suction device for roentgen examination of the colon following colostomy. For description, see text.

if it were tapped by an additional hole drilled at right angles and carried out through the side wall of the device to the brass ferrule at B (Fig. 1).

The inside of the hollowed portion is fitted with a circular piece of rather firm sponge rubber extending to within a few millimeters of the lower rim to prevent trauma to the colostomy mucosa and surrounding skin. This rubber piece is excoriated, as illustrated, on its inferior and superior surfaces, and suitable grooves are made at its inner and outer circular margins to facilitate generalized action of the vacuum on the patient's skin.

A small ledge facing the superior aspect of the device was then formed by routing the 4-cm. center circle a little larger in its superior half. A circular glass window was inserted and immobilized by means of a threaded ring. The short limb of an L-shaped brass connecting tube (A1, Fig. 1), extends through the center of this glass window. Gaskets were used in this window area to produce hermetically sealed joints.

Suitable pressure tubing leads from B to the source of vacuum, which may be either an electrically driven or water-operated vacuum pump. We have used the latter, as it had already been installed for cleaning of enema tips and tubing. This is the type of water filter pump that is in common laboratory use for cleaning pipettes and increasing filtration rate. The distance from the vacuum source to the device is of little consequence; in our existing installation it is approximately 20 feet. With city water pressure the vacuum produced is approximately 27 inches of mercury.

The barium supply is attached to connector A. A urethral catheter or rubber tube of suitable size and length is firmly attached to A1 in such a fashion that it will not come off in the colostomy lumen. In practice a 10-cm. length from a urethral catheter is used. This tubing is lubricated and inserted into the colostomy opening. The bakelite ring is brought in contact with the abdominal wall, enclosing the prolapsed mucosa in the windowed area of the ring. The patient is warned to expect suction on the skin, and the water for the vacuum apparatus is turned on to full capacity.

The colon is examined as it fills, and the patient is rotated for visualization of the areas beneath the opaque examining device. Spot films and anteroposterior survey films are exposed as desired.

Partial evacuation may be accomplished

Fig. 2. Film of colon, filled with aid of suction device at colostomy. Carcinoma demonstrated in ascending colon. Note absence of leakage at stoma and complete filling of colon.

by applying suction at the barium opening, A. In practice, however, at the end of the examination and after survey films have been obtained, pressure is made on the examining device by the attendant, the suction is terminated, and the device disconnected. The patient can then maintain pressure on the device until he reaches a toilet, or a colostomy pad can be slipped under the device as it is removed and the patient can evacuate in a basin or toilet.

Figure 2 is a typical roentgenogram obtained with the aid of this device, demonstrating a carcinoma in the ascending colon eight years after abdominoperineal resection for adenocarcinoma of the sigmoid. We have on record cases in which new or recurrent neoplasms were not demonstrated in the colostomized patient due to inability to fill the bowel completely when other methods were used. Such lesions were subsequently shown by use of the device herein described.

A loop colostomy is examined in a similar fashion. The catheter from A1 is placed in the proximal loop and the bakelite ring brought in contact with the abdominal wall as before. Suction is turned on and the device used merely as a plug for the colostomy while the distal loop is filled per rectum in the usual manner. The proximal colon is next filled by way of A1 and the catheter.

SUMMARY

A suction device is described which facilitates roentgen examination of the colon following colostomy. This device eliminates leakage at the stoma and permits adequate filling of the colon for satisfactory visualization. By its use it is possible to discover pathologic changes which may develop in the remaining segment of colon after abdominoperineal resection for cancer. Further surgery in such cases may mean added years of life.

ADDENDUM: Since preparation of this report, a description of a similar device used for visualization of sinus tracts has been found (3).

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SUMARIO

Artefacto para el Examen Roentgenológico del Colon Después de la Colostomía

El aparato de succión aquí descrito facilita el examen roentgenológico del colon después de la colostomía, por eliminar el escurrimiento por la neoboca y permitir el henchimiento adecuado del colon para una visualización satisfactoria. Con su empleo resulta posible descubrir las alteraciones patológicas que se presenten en el restante segmento de colon tras la resección abdominoperineal por cáncer. Nueva cirugía en esos casos puede representar más años de vida.

Infantile Cortical Hyperostoses

A Review of Cases with a Case Report[1]

WILLIAM S. THOMAN, M.D.[2], and ROBERT E. MURPHY, M.D.[3]

Omaha, Nebr.

THE SYNDROME OF "infantile cortical hyperostoses" was defined and first reported by Caffey and Silverman (1) in July 1945. Since that time, 24 cases have been recorded in the literature.

Clinically this disease is manifested by onset in the early part of the first year of life, irritability and fever, tenderness and swelling of the face and jaws, scapula, or extremities. Radiographically there is evidence of cortical hyperostosis at the above-mentioned sites.

A compilation of the findings in the 24 reported cases is given in Tables I and II. As is shown, the average age of onset was in the twenty-fifth week, with a sex ratio of 14 males to 10 females. The health of the mother was good, except in one instance, and the diet was adequate in all cases. The feeding history was satisfactory in all but 2 infants, one of whom had a low vitamin C intake. Fever and irritability were present in the majority of cases, as was a leukocytosis. Brawny edema of the face occurred in 66 per cent of the children. The alkaline phosphatase was elevated in every instance in which it was determined. The tuberculin test and serologic tests for syphilis were negative in all cases in which they were performed. Serologic tests were done on four mothers and all were negative. Sedimentation rates were obtained in 11 infants and with a single exception were found to be elevated. The red cell count and hemoglobin were below normal in the majority of cases. Infection of various types was present in 7 of the 24 patients. The duration of acute symptoms, as is shown in Table II, varied from one to ten months.

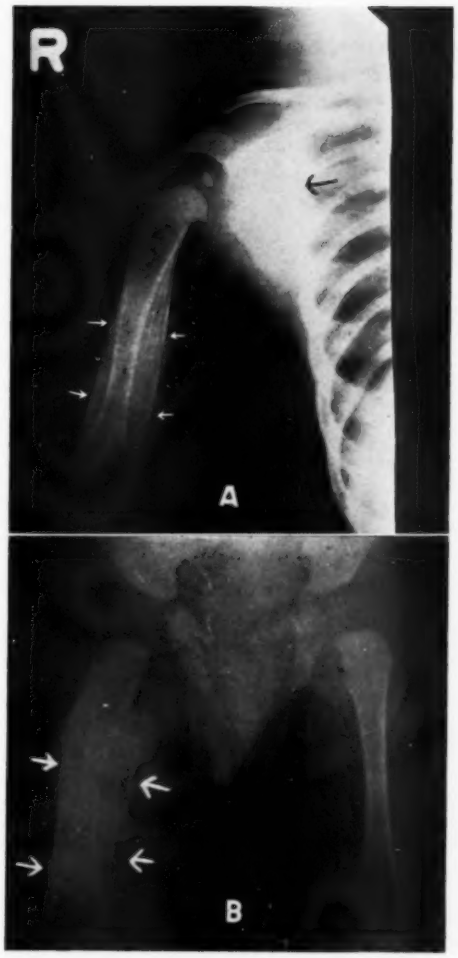

Fig. 1. Films made on admission, showing marked cortical hyperostoses (A) of right humerus and (B) of left femur.

The observations on periosteal involvement are compiled in Table II. As is shown, the most common site is the mandible, followed by the clavicles, upper extremities, lower extremities, ribs, and

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TABLE I: CLINICAL OBSERVATIONS IN 24 REPORTED CASES OF INFANTILE CORTICAL HYPEROSTOSES

Case No.	Health of Mother	Mother's Diet	Sex	Age of Onset (weeks)	Feeding History	Fever	Irritability	Brawny Edema of Face	Alk., PO_4	WBC	Tb. Test	Serology	Sed. Rate	RBC	Hb	Outcome	Mother's Serology
1	Good	Adeq.	M	7	Adeq.	+	+	None		13,000	Neg.	Neg.	Elev.	4.7	71	Recov.	Neg.
2	Good	Adeq.	M	8	Adeq.	+	+	+	22.6	6,000		Neg.	Norm.	2.2	63	Recov.	Neg.
3	Good	Adeq.	M	10	Adeq.	+	+	+	24.2	14,000	Neg.	Neg.		2.3	46	Recov.	
4	Good	Adeq.	M	2	Adeq.	None	None	+	None	Norm.	Neg.	Neg.		Normal		Recov.	
5	Good	Adeq.	F	14	Adeq.	+	+	+	28.9	17,000	Neg.	Neg.	Elev.	4.04	70	Recov.	
6	Good	Adeq.	F	12	Low vit. C	+	+	+	11.0	12,000	Neg.	Neg.	Elev.	4.6	63	Recov.	
7	Good	Adeq.	M	28	Adeq.	+	+	+		17,000	Neg.	Neg.	Elev.			Recov.	
8	Good	Adeq.	F	8		+	+	+	14.3	25,500	Neg.	Neg.	Elev.	3.6	64	Recov.	
9	Good	Adeq.	F	12	Adeq.	+	+	+		29,000					64	Recov.	
10	Good	Adeq.	F	104	Adeq.	None	+	None	28.4	16,000		Neg.	Elev.	3.4	70	Recov.	
11	Good	Adeq.	M	130	Poor	+	+	None		7,000						Recov.	
12	Good	Adeq.	F	16	Adeq.	+			15	13,000		Neg.	142	2.9	59	Recov.	
13	Good	Adeq.	F	72	Adeq.	+	+	None	Norm.	12,000			22	Normal		Recov.	
14	Good	Adeq.	M	1	Adeq.	None	None	+		21,000						Recov.	
15	Good	Adeq.	F	16	Adeq.	+	+	+				Neg.				Recov.	
16	Good	Adeq.	M	64	Adeq.	+	+	None	10.7	14,000	Neg.	Neg.			80	Recov.	Neg.
17	Good	Adeq.	M	11	Adeq.	+		+		24,000	Neg.	Neg.		3.9	50	Recov.	
18	Good	Adeq.	M	12	Adeq.	+	+	+		24,000	Neg.	Neg.		4.7	68	Recov.	
19	Good	Adeq.	F	8	Adeq.	+				17,450		Neg.		3.04	8.2	Recov.	
20	Good	Adeq.	M	15	Adeq.	+	+	+		19,500		Neg.		3.0	gm. 9	Recov.	
21	Good	Adeq.	M	13	Adeq.	+	+	+		14,100	Neg.	Neg.	Elev.	3.2	gm. 8.5	Recov.	
22	Fair	Adeq.	M	12	Adeq.	+	+	None		24,500		Neg.	Elev.	3.6	gm. 9	Recov.	
23	Good	Adeq.	M	12	Adeq.	+	+	+	87	12,700		Neg.		3.3	gm. 62	Recov.	Neg.
24	Good	Adeq.	F	18	Adeq.	+	+	+		17,000				4.3	76	Recov.	

scapulae, in the order named. Tenderness over the involved bone was present in all but 4 cases.

All the patients recovered.

CASE REPORT

W. P. B., a 3-month male Sioux Indian, was admitted to Creighton Memorial St. Joseph's Hospital on Aug. 19, 1948, with a questionable diagnosis of bone tumor or congenital syphilis. The chief complaint was swelling of the extremities. Except that the mother's diet had been poor, the gestation period had not been remarkable. Delivery was normal, and the weight of the child at birth was 7 pounds and 6 ounces. Bottle feedings of evaporated milk were taken well. No vitamin supplements were included in the formula. Both mother and father were well, but the father had received antisyphilitic therapy twelve years earlier. There was a history of tuberculosis in one sibling.

Six weeks before admission, the mother noticed a swelling of the child's right upper arm. This progressed for two weeks, after which time it remained stationary. Four weeks prior to admission a similar swelling appeared in the left thigh. The child was not irritable and no fever was observed at this time. The weight on admission was 11 pounds 14 ounces, and the child appeared well developed and well nourished. The ears and eyes were essentially normal. There was a small ulcerated area on the roof of the mouth and a mucopurulent discharge from the nose. The neck revealed no abnormalities. Examination of the chest showed a scorbutic beading of the costochondral junction. The lung fields and heart were normal. There were no palpable masses or rigidity of the abdomen. The left femur and right humerus were visibly enlarged, and on palpation of these extremities it was noted that the circumference was increased throughout the entire length. There was no tenderness over the swellings.

X-ray films of the right humerus, right scapula, and left femur (Fig. 1) showed marked cortical hyperostoses, changes reported by Dr. D. A. Dowell of the Department of Radiology as typical of the syndrome, infantile cortical hyperostoses (3). Films of the remaining skeletal parts were negative. Nose and throat cultures showed *Staphylococcus aureus*. The blood count revealed 11.5 gm. hemoglobin; 4,080,000 red cells; 17,000 white cells, with a normal differential count. The blood serology was doubtful on the first examination, but was negative on the second and third tests. Spinal fluid examination revealed no abnormal findings. The Lange colloidal gold curve was negative. The alkaline phosphatase, phosphorus, and calcium determinations were within the limits of normal. The tuberculin patch test and the Rumpel-Leede test were negative. The sedimentation rate was elevated.

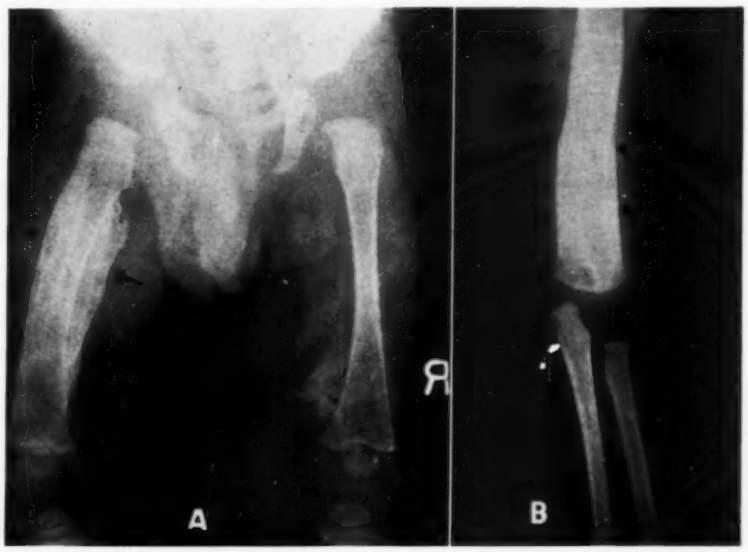

Fig. 2. Films obtained one month after admission, showing some regression of the cortical hyperostoses of (A) the left femur and (B) the right humerus.

On admission, the patient was put on an adequate formula with routine vitamin supplements. Slight fever was present for the first four days, after which the temperature was normal. Re-examination of the blood three weeks after admission revealed 12.5 gm. hemoglobin; 4,820,000 red cells; and 12,250 white cells. X-ray films of the left femur and right

TABLE II: OBSERVATIONS ON PERIOSTEAL INVOLVEMENT, DURATION OF SYMPTOMS, ETC., IN 24 REPORTED CASES OF INFANTILE CORTICAL HYPEROSTOSES

Case No.	Mandible	Clavicle R L	Scapula	Ribs	Upper Extremity	Lower Extremity	Duration of Symptoms	Tenderness	Infection
1	+	– –	None	+	+	+	16 wk.	+	None
2	+	None	None	+	+	+	12 wk.	+	None
3	+	– –	Left	+	+	+	6 wk.	None	None
4	+	– No	Right	None	+	+	15 wk.	+	None
5	+		None	+	None	None		+	Nose and throat
6	+	– –	None	None	+	+	4 wk.	+	None
7	+	– –	None	None	+	+		+	–
8	+	None	None	+	None	None		+	–
9	None	None	None	None	None	None		+	–
10	None	– No	None	+	+	+		+	Ear
11	None	None	None	None	+	+		+	
12	+	None	None	None	+	None	12 wk.	+	Pharynx
13	None	None	None	+	+	+	40 wk.	+	Yes
14	+	None	None	None	None	None	28 wk.	None	–
15	+	None	None	None	+	+	10 wk.	None	–
16	None	No –	None	None	+	+	8 wk.	+	None
17	+	– No	None	None	None	None	6 wk.	+	None
18	+	– –	None	+	None	+	8 wk.	+	None
19	+	– No	Yes	None	None	None		None	None
20	+	– –	None	None	None	None	28 wk.	+	Upper resp. tract
21	+	No –	None	None	+	+	18 wk.	+	None
22	+	None	Right	+	+	+	16 wk.	+	Otitis media
23	None	Both	Both	None	+	+	18 wk.	+	None
24	+	Both	None	None	None	None	24 wk.	+	Upper resp. tract

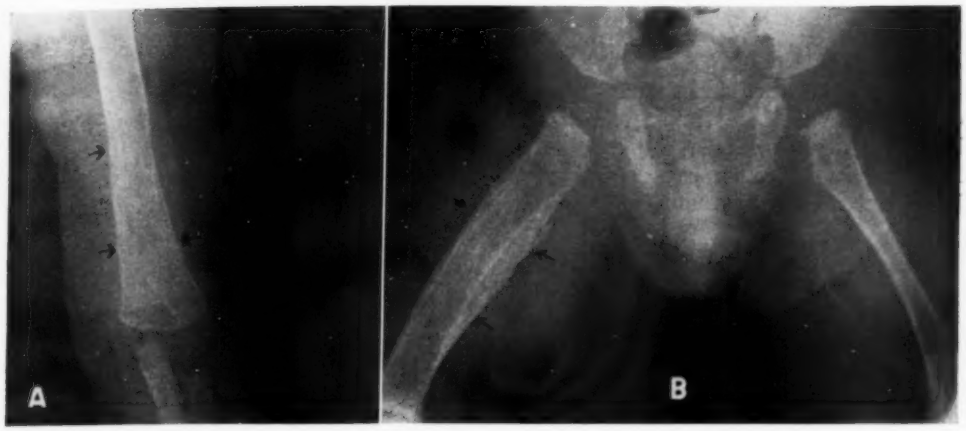

Fig. 3. Films obtained seven weeks after admission, showing almost complete regression of lesions of (A) right humerus and (B) left femur.

humerus one month after admission showed regression of the cortical hyperostoses, with the remaining skeletal parts showing no abnormality (Fig. 2).

The patient's course was uneventful, with a normal gain in weight. Films taken seven weeks after admission showed further regression of the cortical hyperostoses (Fig. 3), and at eleven weeks the patient was discharged, symptom-free and with no abnormal clinical findings.

The clinical features, laboratory data, and x-ray findings in this case coincide with the findings compiled in Tables I and II, and substantiate the diagnosis of infantile cortical hyperostoses. The case is of interest as being the first to be reported in an Indian. Outstanding features are absence of irritability and of involvement of the mandible which is the most common site, the slight elevation of temperature, leukocytosis, and gradual regression of the lesions with no treatment beyond an adequate diet.

The treatment appears to be entirely symptomatic, with adequate feedings, rest, and mild sedation. Penicillin and sulfadiazine have been proved to be of no value in the treatment (2) and ascorbic acid has not altered the course of the disease, although this is in disagreement with the views of Brailsford (12).

SUMMARY

A brief review of the findings in 24 reported cases of infantile cortical hyperostoses is given, and a case in an Indian infant is reported.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Hiperostosis Corticales en la Infancia. Repaso de Casos con una Historia Clínica

Ofrécese un breve repaso de los hallazgos en 24 casos de hiperostosis corticales en la infancia, describiéndose un caso en un lactante indio. Las características sobresalientes consistieron en la falta de irritación y de invasión de la mandíbula, que es el asiento más común, la leve elevación térmica, la leucocitosis y la regresión de las lesiones sin ningún tratamiento aparte de una alimentación adecuada.

Methods of Marking the Plane of Section in the Open Lobotomy Operation[1]

BENJAMIN BRADFORD WHITCOMB, M.D., and WILLIAM BEECHER SCOVILLE, M.D.
Hartford, Conn.

A NUMBER OF METHODS have been devised for visualizing the plane of section following lobotomy. Lipiodol was used successfully for this purpose by Freeman and Watts (1), but in the "open" lobotomy the lipiodol may fall to the basal cisterns or enter the lateral ventricles and be distributed throughout the spinal fluid pathways of the brain and spinal cord. A gross method used by the authors and others has been the application of silver clips at the base, mid-portion, and apex of the vertical plane of section in the open operation. An angled clip applicator is useful for insertion of these clips at the base of the plane of section.

Putnam (2) first suggested the use of tantalum wire markers in various types of lobotomy. For the standard open lobotomy operation and for cortical under cutting of selected areas of the prefrontal cortex (as performed by Scoville), the authors have used 30-gauge stainless steel wire loops as markers, bending the tips of the loops backward upon themselves in order to blunt them (Fig. 1). This procedure has been employed in 43 cases over a period of nine months, with 3 instances of nonrecurrent convulsions.

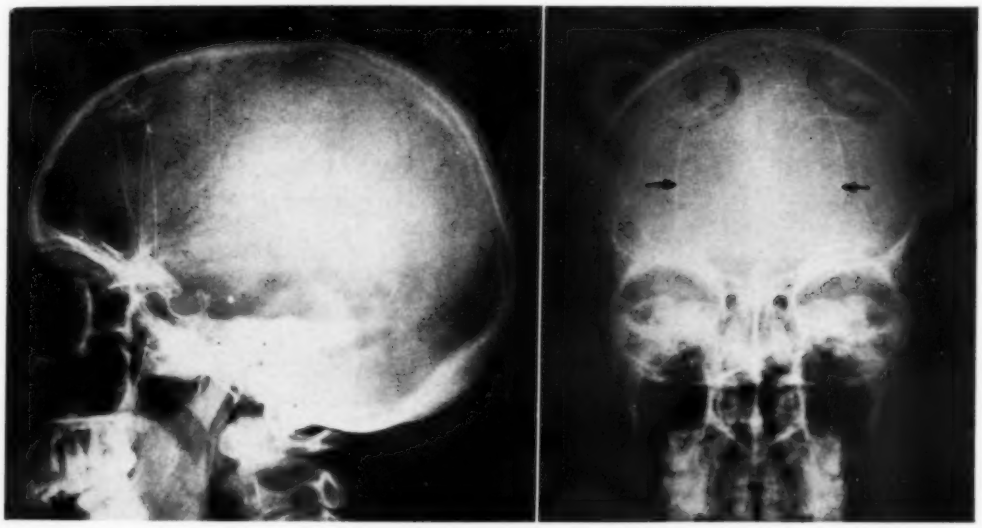

Fig. 1. Lateral and anteroposterior views showing stainless steel wire loop markers in position.

A new method of marking the plane of section, to be presented here, makes use of tantalum powder,[2] which has also been used by Hamby (3) for marking the site of operation for protruded lumbar disks.[3]

[1] From the Neurosurgical Services of the Hartford Hospital and Institute of Living, Hartford; Connecticut State Hospital, Middletown; Norwich State Hospital, Norwich, Conn.; Veterans Hospital, Northampton, Mass. Accepted for publication in June 1949.

[2] Manufactured by the Ethicon Suture Division of Johnson & Johnson, New Brunswick, N. J.

[3] The tantalum powder used must be distinguished from tantalum oxide, which is an irritant. The powder is the dust of pure tantalum and contains only a minimal amount of the oxide.

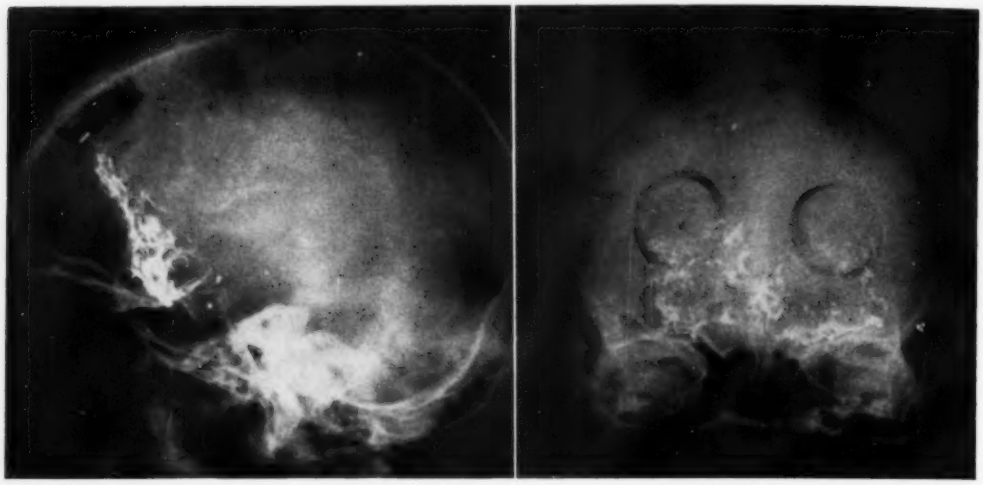

Fig. 2. Lateral and anteroposterior views illustrating use of tantalum powder as a marker.

This extremely fine powder is purchased in 1-gm. amounts, in the form of a heavy black dust, and may be placed in a standard powder atomizer and insufflated into the plane of section at the end of the lobotomy procedure. It adheres to the margins of the section and does not appear to enter either ventricle or basal cisterns. Postoperative anteroposterior and lateral films (Fig. 2) reveal both the vertical and lateral extent of the plane of section. This method has been used in over 125 cases without visible harmful effects or any increase in the incidence of epilepsy.

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SUMARIO

Método para Demarcar el Plano de Resección en la Operación de Lobotomía Abierta

Un nuevo método para demarcar el plano de corte en la operación de lobotomía abierta utiliza un fino polvo de tantalio que contiene un mínimo de óxido de tantalio. El polvo es insuflado en el plano de resección al terminar la operación. El procedimiento ha sido empleado en más de 125 casos sin efectos adversos aparentes.

The Relative Biological Effectiveness of Beta and Roentgen Radiation as Shown by the Radiotoxicity of Na^{24} for Mice[1]

R. H. SNYDER, Ph.D.,[2] and W. E. KISIELESKI, M.S.

IN THE EARLY work of the Biology Division of the Metallurgical Laboratory (Argonne National Laboratory), a brief study was made of the toxicity of radiosodium for mice. The determination of an acutely lethal dose, the gross toxic effects, and the excretion of the administered material were included.

Since sodium is distributed fairly uniformly throughout the body (1–3), radioactive sodium approaches the total-body type of irradiation produced with x-rays. Therefore, a comparison of the relative biological effectiveness of beta rays and x-rays can be made. The importance of such comparisons, and the theoretical considerations involved, have been pointed out by several reviewers (4, 5). It is generally accepted that the biological effects of the various ionizing radiations are qualitatively alike but quantitatively different when the total amount of energy absorbed is compared. The quantitative differences are believed to be proportional to differences in the specific ionization of the radiations. Therefore, since the specific ionization of moderately hard x-rays is about ten times that of beta rays, the former should be more effective in producing a given biological change than an equal amount of energy from the latter.

In support of these concepts, Stapleton and Zirkle (6, 7) have obtained data on the irradiation of Drosophila eggs which show an effectiveness ratio of 1.6 for x-rays compared with beta rays. Evans and Quimby (3) found that 47 μc. of Na^{24} per gm. produced the same degree of lymphopenia in mice as did 450 r of 200-kv. x-radiation. With a more recent value for the average energy of the sodium β than used in the paper cited, the 47 μc. per gm. was found to yield a dose of about 660 equivalent roentgens (8), indicating an effectiveness ratio of 1.5. Crabtree and Gray (9), however, found a ratio of 1.0 for the inhibition of glycolysis in rat retina. It is evident that the existing data are limited, and have not included the lethal effects of internal emitters on mammals. Since the results of the Na^{24} toxicity experiments were concerned with these effects and could be applied to the comparison problem, it was felt that a report of some of the data obtained would be of interest.

EXPERIMENTAL

The radioactive sodium used was the 14.8-hour isotope of mass 24 produced by deuteron bombardment of metallic sodium in the University of Chicago cyclotron. After bombardment, the sodium was dissolved in 50 per cent alcohol, made acid with HCl and then just alkaline with ammonia and treated with H_2S to remove any copper or aluminum picked up from the target and shield. The solution was evaporated, the solids were baked, and then heated over a free flame to remove ammonium salts. After redissolving, filtration, and re-evaporation to dryness, the NaCl was weighed and dissolved in water to make a 1.8 per cent neutral solution. The highest specific activity obtained in any of the preparations was 0.32 curies per gram of sodium (calculated to the end of bombardment). This relatively low activity necessitated the injection of large amounts of sodium chloride (0.5–1.5 mg. per gm.) to secure the desired amount of radiation. Carrier-free[3] preparations would have been desirable but could not be obtained in sufficient quantity at the time of these experiments.

[1] From the Biology Division of the Argonne National Laboratory, Chicago, Ill. Accepted for publication in May 1949.

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[3] *i.e.*, with no measurable non-radioactive isotope of sodium present.

The experimental animals included CF1 male, brown, white, and black ABC male, brown Swiss male, and white ABC female mice. The mice averaged 20 gm. in weight, although individual weights varied from 15 to 30 gm. In two experiments, deviation in effect due to difference in weight was prevented by injection of each animal on a per gram basis. In two experiments where the correction was not made, variation from the average dose per gram within groups (5 to 10 mice) was occasionally as much as 20 per cent.

The solutions as prepared above (or dilutions of them) were injected intraperitoneally in volumes of from 0.5 to 2.0 ml. One group of control animals in each experiment received inactive saline in a volume and concentration approximately equal to the largest dose given the experimental animals; another group was left untreated.

The excreta were collected in bowls placed beneath group cages. Samples were collected by spraying the bottom of the cages with water and washing the wet mixture of food, feces, and urine into beakers. After addition of about 100 ml. of concentrated HNO_3 the samples were evaporated to dryness, and the residue was taken up in hot water, filtered, and washed several times. This method resulted in losses of about 1 per cent of the activity to the discarded residue. The filtrate and washings were made to a known volume, and aliquots of appropriate size were evaporated to dryness in 10-ml. Coors ashing capsules for determination of the radioactivity. All measurements of activity were made with a Lauritsen electroscope which had an aluminum window of 2 mg. per square centimeter thickness, and an air space from the sample to the window of 3.0 cm, resulting in a total absorption equivalent to 5.4 mg. per square centimeter of aluminum. The electroscope was calibrated for Na^{24} by comparison with a Geiger-Müller counter previously standardized with uranium. It was found, under the conditions of measurement used, that 1 μc. produced a discharge rate of 0.89 divisions per second. The accuracy of determination of the absolute activity appeared to be within 10 per cent. A more complete discussion of the calibration methods used in this laboratory and their accuracy has been given by Broido (10).

RESULTS

Excretion and Analytical Recovery: Mixed urine and feces were collected periodically until the end of the experiment and were measured for radioactivity as described. The results were corrected to account for the animals that died during collection intervals; the excretion curves so obtained are shown in Figure 1. Curve I shows the average excretion of the isotope by all of the mice studied. This amounted to 33 per cent of the injected dose in twenty-four hours and 50 per cent in seventy-two hours. Also shown are curves (II and III) for the groups that excreted the least and the most, respectively, the excretion of all other groups falling within these limits. There was no consistent correlation with the dose of sodium chloride within the range involved in the rather high dosages used (0.5–1.5 mg. per gm.). The results are in fair agreement with those of Evans and Quimby (3) for mice, obtained by measuring the decrease in the external gamma count of the animals at intervals after injection. Their data indicate an excretion in seventy-two hours of about sixty-five per cent of the total dose.

Whole carcasses were ashed and analyzed in order to determine the analytical recovery of the injected material. Where sufficient undecayed sodium remained to permit an accurate measurement, the total recovery ranged from 83 to 104 per cent, with an average of 90.

Acute Radiotoxicity—Lethal Action: In all, about 200 mice were given doses of radiosodium ranging from 12 to 150 μc. per gm. of body weight. On the per gram basis, 65 to 150 μc. caused 100 per cent mortality within ten days, while doses from 35 to 65 μc. gave 100 per cent mortality in from ten to twenty days. Still lower doses did not cause 100 per cent mortality in twenty days, the period chosen in defin-

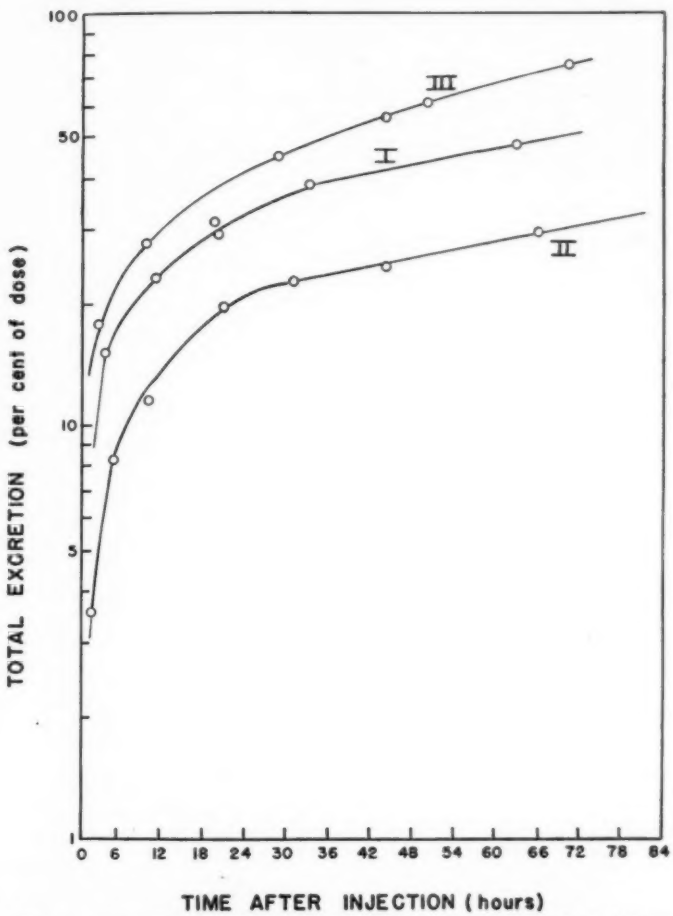

Fig. 1. The excretion of Na^{24} by mice following intraperitoneal administration. Curve I. The average excretion rate for all mice observed. Curve II. The lowest excretion observed in 27 groups (average of 7 mice treated with 43 μc. Na^{24} per gm. and 0.7 mg. NaCl per gm.). Curve III. The highest excretion observed in 27 groups (average of 5 mice treated with 23 μc. Na^{24} per gm. and 0.4 mg. NaCl per gm.).

ing the toxicity as "acute." Final results were expressed in terms of the twenty-day LD 50 (the medium lethal dose), which fell between 20 and 40 μc. per gm. Certain irregularities within this range were attributed to differences in excretion and to the relatively small numbers in each group, with consequent biological variation greater than the dose increments used. These irregularities were largely eliminated when groups from different experiments, receiving approximately the same dose in μc., were combined. A summary of the data obtained is presented in Figure 2, from which the interpolated value for the twenty-day LD 50 is seen to be 30 μc. per gm. The variety of strains and sexes used, and the rather small numbers of any given one, precluded study of variation in their relative sensitivity.

Radiation Dosage and Relative Biological Effectiveness: Assuming uniform distribution of the sodium, and with other necessary assumptions to be discussed later, it was possible to calculate the dosage in total-body radiation received by the mice, using the general formulation (11, 12):

$$I = 61 \times E \times Q/W$$

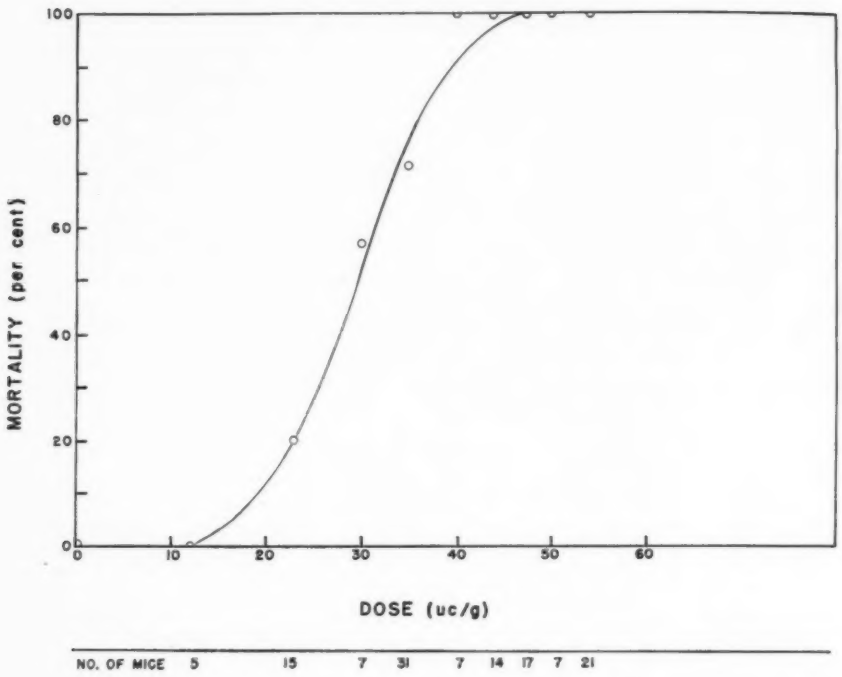

Fig. 2. The lethal effect of Na^{24} in mice (based on the number of deaths in the first twenty days after intraperitoneal injection).

where E is the average energy of the radiant particle in electron volts, Q is the quantity of deposited radioactivity in curies, W is the weight in grams of the tissue receiving the radiation, and I is the intensity in rep per day.

The average energy of the sodium β was taken as 0.54×10^6 ev. (11) and W was the average weight for the group. A value for Q was found by plotting the retained (injected less excreted) amount of sodium against time, allowing for decay, to give an "effective dose" curve (Fig. 3). The dose in curie-days was equal to the area under this curve. Substitution of these values in the formula gave the total dose in rep.

On the basis of this calculation, the average radiation dose to the animals for the different amounts of sodium given varied from <200 to >2000 rep. In some cases the doses were not in the same order as the doses in μc. and/or were inconsistent with the lethal effect. This was probably due to the factors mentioned with respect to the dose in μc., with the added errors involved in determining the effective dose. Again, combination of the groups receiving similar doses eliminated the irregularities and a curve similar to that of Figure 2 was obtained. The interpolated twenty-day LD 50 taken from the curve was 680 rep.

Hagen and coworkers (13), working in this laboratory at the same time and with similar mice, obtained a value of about 500 r as the twenty-day LD 50 for 200-kv. x-rays. This offered a direct standard of comparison from which the ratio of x-ray to beta-ray effectiveness appeared to be about 1.4.

DISCUSSION

The calculation of the dose in rep received by the mice did not include absorption of the gamma-ray energy of the isotope. Although a small fraction was absorbed by the animals, it was assumed that an error of roughly equal magnitude in the opposite direction was caused by ignoring the loss of

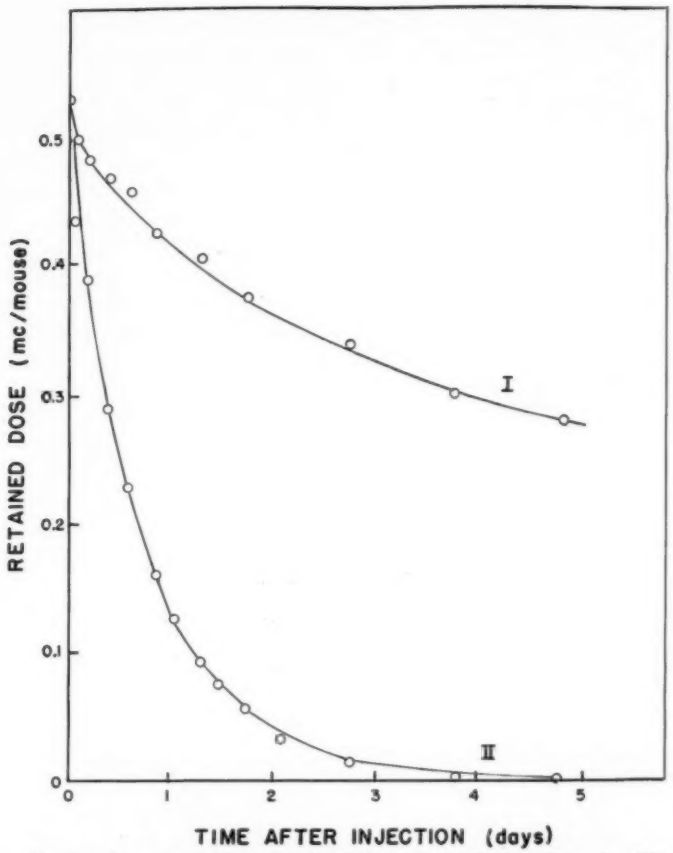

Fig. 3. A representative effective dose curve for Na^{24}. Curve I. The retention of the injected dose. Curve II. The retained dose decreased by decay of the isotope in the body.

some beta-ray energy through the skin. Evans and Quimby (3), on the other hand, included an estimated 25 per cent loss of beta energy in their calculations while disregarding the gamma-ray absorption. This difference in procedure contributes to the apparent agreement of their effectiveness ratio of 1.5 with the one obtained here.

The further assumption was made in the calculations that the energy of the beta particles was equally absorbed by all the body tissues. This is obviously in error, but the error cannot be great. Blood, usually the richest tissue in sodium content, does not absorb all the energy from the disintegrations that take place within it, a considerable fraction being absorbed by the capillaries and surrounding tissues.

Neglect of the difference in dose rates was another source of error since the roentgen radiation was given as a single dosage in about thirty minutes, while the beta radiation was given over a period of several hours. That this is important was shown by Henshaw *et al.* (14), who found that, in the case of external gamma radiation, increasing the exposure period by ten times reduced the effectiveness of a given dosage by about 30 per cent. Thus, the true ratio would tend to be less than that actually found.

Another assumption made was that the isotope was uniformly distributed throughout the body and thus approached the condition of total-body irradiation. Published data on the distribution of sodium in

the mouse are slight, and none were gathered here, but from the data of Evans and Quimby (3), and from the situation in other mammals, the assumption appears to be a safe one. Evans and Quimby found that the tissue distribution, with the exception of muscle, rarely varied more than from 0.5 to 1.0, with blood taken as 1.0. Muscle was usually as low as 0.2 to 0.3. Similar results have been reported for rats and rabbits (1, 2). At least it is apparent that there is no gross accumulation in any tissue, and that equilibrium values are reached very shortly after administration. This assumption may prove, however, to be an oversimplification. Since the blood is one of the richest tissues in sodium content, it may prove to be very important that tissues with a large blood supply receive a greater than average dose, especially if these same tissues are more sensitive to radiation than others and therefore more important in determining the LD 50. Other considerations, such as the fact that the sodium is mainly in the extracellular fluids, also may serve to invalidate the assumption of uniform total-body irradiation and the simple application of the "61" formula.

The algebraic sum of the error of these assumptions and other possible errors, such as incomplete analytical recovery, uncertainty in the absolute determination of the dose in μc., and uncertainty in some of the constants of the conversion formula, contributed in producing the result obtained; that is, that the beta-ray LD 50 was 680 rep and that, therefore, x-rays were 1.4 times as effective as beta rays.

This effectiveness ratio is in good agreement with the ratios of 1.5 and 1.6 previously found under other conditions by Evans and Quimby, and by Stapleton and Zirkle, respectively, and referred to above. Although this agreement indicates accuracy, evidence to the contrary is found by comparison with the data of Henshaw *et al.* (14). Using tantalum gamma radiation delivered at the rate of 3 r per minute, they found the LD 50 for mice to be 1100–1200 r. Since the specific ionization of both beta rays and gamma rays is practically unity, the effectiveness ratio should be approximately 1.0. In addition, Henshaw's dosage rate agreed more favorably with the beta rate used in the experiments reported here than did the rate of x-ray dosage used for the comparison. Thus, so far as can be determined, their value of 1100–1200 r for the gamma-ray LD 50 should compare with the beta-ray LD 50 of 680 rep found here. Excluding the existence of factors that are not apparent, the best qualitative explanation for this discrepancy would be based on non-uniformity of the distribution and effect of the sodium, as previously discussed.

Since the information at hand does not permit a further resolution of the various factors that have been considered, it can only be concluded that, as measured, x-rays are 1.4 times as effective as internally deposited beta emitters in causing acute toxicity and death in mice.

SUMMARY

Mice were injected intraperitoneally with doses of radioactive sodium^{24} ranging from 12 to 150 μc. per gm. of body weight. The twenty-day LD 50 was found to lie between 20 and 40 μc. per gm., the final value arrived at by interpolation being 30 μc. per gm. The calculated radiation dosage corresponding to this twenty-day LD 50, considering excretion and decay, was 680 rep.

About 30 per cent of the injected dose was excreted in the first twenty-four hours and 50 per cent in seventy-two hours, with the amount of sodium chloride included in the injection ranging from 0.5 to 1.5 mg. per gm.

Discounting the systematic errors and the uncertainty for x-ray comparison under the conditions used, it was found that the ratio of x-ray to beta-ray effectiveness is approximately 1.4:1.

ACKNOWLEDGEMENT: It is a pleasure to record our indebtedness to Dr. R. E. Zirkle for his kindness in criticizing the original draft of the manuscript.

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* Information regarding the availability of these reports may be obtained at the following address: Document Sales Agency, P. O. Box 62, Oak Ridge, Tenn.

SUMARIO

La Relativa Efectividad Biológica de la Radiación Beta y Roentgen según la Revela la Radiotoxicidad del Na^{24} para los Ratones

Inyectáronse intraperitonealmente en ratones dosis de sodio radioactivo^{24}, recibiendo los mismos de 12 a 150 microcuries por gramo de peso vivo. La dosis letal media de veinte días resultó ser de 20 a 40 microcuries por gramo, siendo la cifra definitiva, obtenida por interpolación, 30 microcuries por gramo. La correspondiente dosis de radiación calculada, considerando la excreción y la descomposición, fué 680 rep.

Aproximadamente 30 por ciento de la dosis inyectada fué excretado en las primeras veinticuatro horas y 50 por ciento en setenta y dos horas, oscilando entre 0.5 y 1.5 mg. por gramo la cantidad de cloruro de sodio comprendida en la inyección.

Descontando los errores sistemáticos y la incertidumbre que rodea a la comparación de rayos X en las condiciones del experimento, los rayos X resultaron ser 1.4 veces tan eficaces como los emisores de rayos beta depositados internamente, en lo tocante a provocar toxicidad y muerte en los ratones.

A Stereoscopic Viewing Desk Designed for Limited Space[1]

DESMOND T. BURKE, D.M.R.

Toronto, Ont.

WITH THE OPENING of the new Sunnybrook Hospital by the Department of Veterans Affairs of Canada, one of the problems which presented itself was the optimum disposition of viewing equipment and office furniture in some offices as narrow as $9^1/_2$ feet. Since a conventional Wheatstone stereoscope occupies a space 2 feet wide by approximately 7 feet long, many of the radiologists neglected the advantages of stereoscopic viewing because of the awkwardness entailed.

In one of the offices, the problem has been solved as demonstrated in the accompanying illustration. In two of the others, slight modifications of this scheme are being tried.

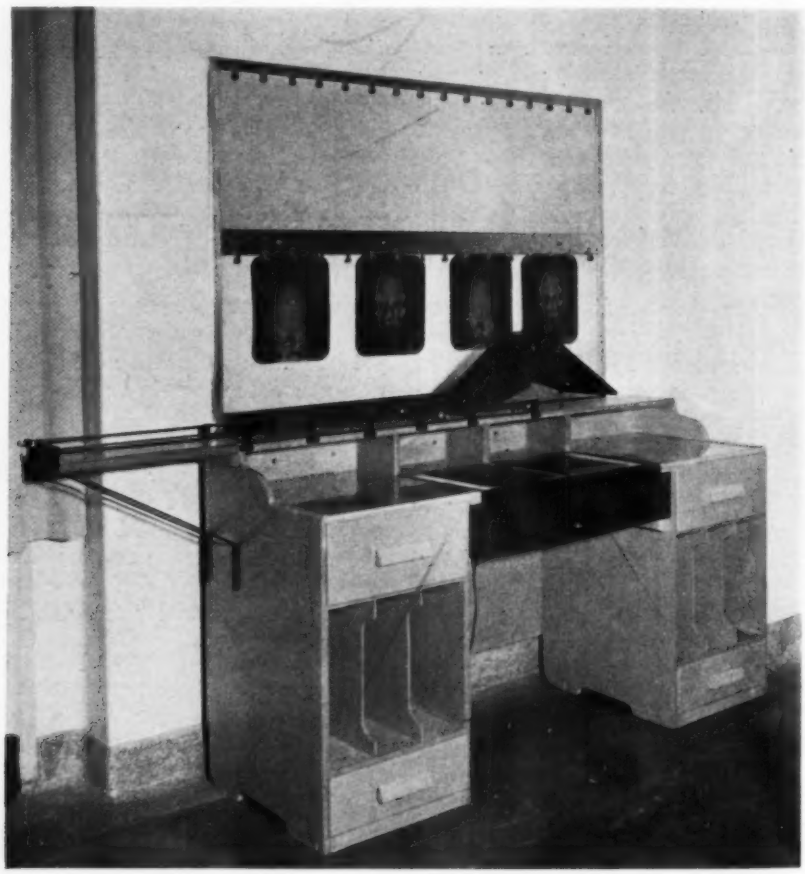

Fig. 1. Stereoscopic viewing desk. For description see text.

The desk part measures 21 inches from

[1] From the X-Ray Department, Sunnybrook Hospital, Toronto, Ontario. Accepted for publication in May 1949.

back to front, 31 inches in height and 64 inches in length. At the back of this desk and extending about one foot beyond it on the left side is a small platform with rails for the mirror system. In the center of the desk is the stereo view box system consisting of two viewing areas 11 3/4 inches square, inset so as to be flush with the table top. This double illuminator can be pulled out, in the same manner as a drawer, for repairs.

The mirror system of this particular unit was removed from its mount, which consisted of two parallel pipes attached to each end of the viewers, and was remounted on thin-gauge sheet steel extending to the rails on the narrow platform mentioned above. These retaining rails run sufficiently far out on the platform so that the mirror system may be pulled into position in the midline of the desk and stopped by a rubber stopper or pushed sufficiently far to the left that it does not obstruct the use of any of the eight conventional panels in the wall.

This viewing desk has been in use by many members of the X-Ray Department for some time and the consensus of opinion is that it is an ideal arrangement from the point of view of economy, space requirements, and convenience.

The commercial stereoscope altered in the manner suggested above was supplied by the F. & R. Machine Works, Long Island, New York. It is known as a Stanford Junior Model. I believe it was designed by Dr. W. E. Chamberlain.

Sunnybrook Hospital
Toronto 12, Ontario
Canada

SUMARIO

Escritorio para Estudios Estereoscópicos en Espacio Limitado

Para resolver las dificultades creadas por la falta de espacio, se diseñó el escritorio para estudio estereoscópico aquí reproducido. La porción estereoscópica del mismo consiste en un estereoscopio modelo Stanford Junior que tiene la parte de observación hundida en un escritorio y el juego de espejos montado en correderas de modo que puede desviarse a un lado cuando se desea emplear los miradores corrientes en la pared.

El escritorio mismo mide 52.5 cm. de atrás al frente, 77.5 cm. de alto y 1.6 m. de largo.

EDITORIAL

Use of Radioisotopes in Medical Practice

Radioactive materials for diagnosis and treatment are enormously attractive to the medical profession. They are new, and more than a little mysterious, and their powers still largely unexplored. Novelty and power are two valid reasons: novelty in promising methods of attack on old problems; power to apply energy intensely in localized areas or systems, and power to make measurements of quantities and concentrations fantastically tiny. Over all is the pervading cloud of newspaper publicity concerning nuclear energy and atomic fission, on which the acid of U.S.S.R. intransigeance continually condenses, converting a fairly benign fog into a corrosive smog.

The monopoly of the Atomic Energy Commission with its chain-reacting-pile factory for radioactive isotopes is but little cut in upon by the several cyclotrons, for the latter are pretty small-scale producers in comparison, and the product is held captive by the needs of their own domestic research teams. The Atomic Energy Commission looks upon radioactive isotopes for medical purposes strictly as instruments for research, or shall we say clinical investigation.

It is clear, therefore, that radioisotopes are tools to be made available to persons and teams engaged in research, but not for the normal everyday care of sick people. The technics of their use are difficult and strange, and the hazards encountered are threatening to patient, doctor, and bystander (1). One hardly trusts any individual working alone to engage in research employing radioactive materials. The patient's well-being requires a clinician's care. The investigation's success requires disciplines belonging to the fields of physics, chemistry, and biology. The safety of all requires a degree of vigilance amounting to a continuous self-criticism of habits and technics, most effectively assured in a laboratory climate where every member feels himself under the watchful eyes of every other member of the team.

The widespread use of radium externally and interstitially by individual practitioners has become ordinary practice, it is true. But one is aware of abuses in this field revealed by injuries to patients and to practitioners, injuries which could have been avoided by sufficient consultation with persons better acquainted with the measurement of radiation and its biologic effects. At any rate, the Atomic Energy Commission will not allocate radioactive isotopes except to institutions adequately staffed and furnished with adequate instruments and equipment. Moreover, the Commission must be assured of the adequacy of training and indoctrination of the clinician or biologist who will use the material, and requires an outline of the research project for which it is needed. All these requirements are very frustrating to the energetic and conscientious practitioner who prides himself on keeping down to date and who has undoubtedly a number of patients whose diagnosis and treatment are not entirely satisfactory under the present state of the medical art.

How badly are doctors being treated under these restrictions? Or rather, how much is treatment of sick people being compromised? Are we going to let the Atomic Energy Commission tell us in effect: Radioisotopes may be needed for the advancement of medical science, but down to now, at least, not needed for the care of an individual patient? Or, more sharply: No doctor can rightly complain that he is being stopped from doing his

duty to his patients, and no patient can rightly complain that essential therapy is being withheld from him, because of these restrictions on radioactive isotopes?

Of course, if the difficulty were mechanical—if the treatment were unavailable because the doctor lacked the proper machine (a betatron for instance)—one would be more submissive, and more ready to circumvent the difficulty by referring the patient whither the machine might be available. But the fact that the essential machinery is mostly in personnel and background makes all of us view the lack as more possibly surmountable, if only the motivation be sufficient.

Let us, however, temper our self-reliance with a sense of humor. Let us keep our eyes well open to the hazards, especially the novel hazards, of this new field. And especially let us keep ourselves informed about the real worth of these new methods for clinical medicine. For physiologic research one is willing to grant an almost limitless promise for the use of isotopes. The only visible limits are the finite ingenuity and inventiveness of the investigators. Progress in some of these lines has been spectacular, as for instance in tracing and measuring the iron-hemoglobin-red-cell cycle. Application of such physiological advances to the care of sick people, however, is usually non-isotopic. That is to say, the radioactive isotopes are used in making the discoveries, but not in the clinical applications of those discoveries.

There are, of course, a few clinical tests which can be done best with isotopes. Whether we will end up by considering P^{32} the "standard" method for blood volume and Na^{24} for circulation time, etc., cannot now be predicted. Whether new clinical measurements will be developed and shown to be important, measurements, impossible except with isotopes, have yet to be discovered. For the clinician in his care of patients, however, one cannot today point to any essential measurement or test that absolutely requires isotopes for its satisfactory performance, with the possible exception of iodine uptake by the thyroid.

This brings us to the real crux of the question: What uses of radioactive isotopes ought to be made available to doctors working in hospitals generally, so that they may do their duty by their patients? One ought to list the several uses that seem important:

(*a*) I^{131} as a tracer to measure thyroid function. Some physicians now look upon this as very valuable, as valuable as the measurement of basal metabolic rate, or more valuable. As a treatment for Graves' disease, most people would set I^{131} second to thyroidectomy. Whether this order of choice will some day be reversed remains to be seen. As a treatment for thyroid carcinoma the isotope is applicable in but few cases, but in these it is irreplaceable. On account of these few cases, should we give a test dose of I^{131} routinely before every thyroid operation so as to be prepared for radioautographic estimate of uptake in any thyroid tumor discovered? No explicit demand for such a policy has yet been promulgated. But perhaps we ought to.

(*b*) P^{32} is perhaps the treatment of choice for polycythemia vera. It is not an emergency requirement. Blood-letting is still good treatment. Cases of this disease are not many. They can be referred to a consultant who does have P^{32} available.

For chronic leukemia P^{32} is good treatment. It is not demonstrated, however, to be better than x-rays. Neither does it achieve any cures. For acute leukemia P^{32} is just as disappointing as anything else.

(*c*) External applications as a substitute for radium and x-rays are being tried and reported. P^{32} on blotting paper makes an elegant and precise beta ray source for the treatment of skin lesions. Sr^{90} shows promise as a concentrated beta ray source, particularly for ophthalmic treatments. Co^{60} has received some publicity as a cheap substitute for radium. Some clinical work shows how nicely it adapts itself to the mechanical requirements of interstitial irradiations, and also intracavitary treatments. Since the Atomic Energy Commission has reduced the price for large quantities of Co^{60}, several ambitious persons

are contemplating design of really large "cannons" or "bombs" which would do the work of a 2-megavolt x-ray tube. We hear that one such has been built.

These external uses are all such as can be accomplished by x-rays or radium. They may have their points for elegance, flexibility, economy (and novelty), but they are not yet proved essential.

No doubt there are other clinical uses of radioisotopes that other commentators would list as promising for everyday medicine, but the above seem to be the only ones that stand out. Having looked them over again, one feels that their sum total is not too large, is in fact quite small compared to the limitless promise of radioisotopes for basic medical and physiological and biochemical research.

The radiologist is undoubtedly looked to by his fellow physicians as the exponent and practitioner of all medical things radioactive. It behooves him to keep himself informed about progress in this field and so be prepared with explanation and evaluation of novel reports in the scientific press and excited reports in the lay press. He will be asked many a time in relation to radioisotopes: "Is there anything in it?" But at present he has but little obligation, from a clinical standpoint, to undertake their use. And he has no cause to blush when the question asked is not: "Is there anything in it?", but, rather more pointedly: "Do you do it here?"

Clinically, therefore, radioisotopes are hardly as yet an obligation. And research should be looked on not as an obligation but as an opportunity and a privilege.

R. R. NEWELL, M.D.

The Advisory Editorial Board

No one of the sciences stands alone. Each serves and is served by others. Particularly is this true of the medical specialties. One has but to skim through an assortment of medical journals to gain some faint appreciation of the contribution of radiology to other fields. On the other hand, a glance at any textbook on roentgen diagnosis or therapy will reveal the dependence of the speciality on such sciences as physics, anatomy, physiology, and pathology, to name but a few.

The Publication Committee and Editor of RADIOLOGY have for some time had under advisement the creation of a small but active Advisory Editorial Board, representative of some of these basic related sciences. It is gratifying to be able to announce that, with the appointment of three eminent authorities in their respective fields, this Board has become a reality.

Dr. Edith H. Quimby, of the College of Physicians and Surgeons, Columbia University, whose outstanding achievements in the field of medical physics are universally recognized, and to whom RADIOLOGY is already greatly indebted for innumerable services, has consented to serve as consultant in medical physics. Dr. Arthur Purdy Stout, surgical pathologist in the Department of Surgery of the same institution, will act as consultant on problems of pathology, while Dr. Harold Cummins, Professor of Anatomy, Tulane University, and Editor of the *American Journal of Anatomy*, will represent his specialty.

We believe that with the advice of these authorities, many problems will be clarified, that terminology and descriptions can be made more exact, and, in short, that RADIOLOGY will be rendering a still greater service to its readers and contributors.

ANNOUNCEMENTS AND BOOK REVIEWS

ATLANTA RADIOLOGICAL SOCIETY

At a recent meeting of the Atlanta Radiological Society, Dr. William W. Bryan was elected President; Dr. George Hrdlicka, Vice-President; Dr. Ted F. Leigh, Emory University Hospital, Secretary-Treasurer.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY

The Annual Mid-Summer Conference of the Rocky Mountain Radiological Society will be held in Denver at the Shirley-Savoy Hotel, Aug. 17–19. An excellent program is being arranged, details of which will appear later.

PHILADELPHIA ROENTGEN RAY SOCIETY

A testimonial dinner was given by the Philadelphia Roentgen Ray Society on March 23, 1950, to honor Bernard P. Widmann, M.D., President-Elect of the American Roentgen Ray Society, and Barton R. Young, M.D., Secretary, American Roentgen Ray Society.

The dinner, which was held at the Barclay Hotel, was attended by 125 doctors of the Philadelphia Roentgen Ray Society and friends of the honored guests. Silver pitchers suitably inscribed were presented to Dr. Widmann and Dr. Young.

NATIONAL RESEARCH COUNCIL ANNOUNCEMENT

The National Research Council announces the availability of funds for fundamental research in the field of radiology. This has been made possible by the James Picker Foundation, established in 1947 by Mr. Picker and his family. Capital funds of the Foundation now approximate $400,000.

The announced objectives of the James Picker Foundation are "to provide funds to foster research and broaden the scope of radiology."

For the year 1950, $15,000 from income will be available for research. In allocating these funds, especial consideration will be given to fundamental work in radiology and its applied fields. The Foundation has specifically requested that none of its funds be used to subsidize the development of radiological equipment.

The National Research Council has been designated as the scientific advisory body of the Foundation. It is expected that applications will be considered by the Council's Committee on Radiology under the Chairmanship of Dr. Eugene Pendergrass. Final determination of the awards will be made by the Directors of the Foundation upon the recommendation of the National Research Council.

The Directors of the James Picker Foundation are: Harold E. Stassen (*Chairman*), President, University of Pennsylvania; General Georges Doriot, Professor, Harvard University; Ivan Dresser, Vice President, General Motors Overseas Corporation; Ross Golden, M.D., Professor of Radiology, College of Physicians and Surgeons, Columbia University, New York.

Applications for fellowships in the field of radiological research, with stipends of the order of $3,000 to $5,000, depending upon the qualifications and special circumstances of the applicant, will also be entertained.

Applications for research grants and fellowships available during the year beginning Jan. 1, 1951, may be made until Sept. 15, 1950, and are *not* limited to citizens of or laboratories in the United States.

Inquiries should be addressed to Secretary, Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

ISTITUTO DI RADIOLOGIA DELL' UNIVERSITA, GENOA, ITALY

Announcement has been made of a course in the Theory and Practice of Stratigraphy to be conducted under the direction of Professor Alessandre Vallebona at the Radiological Institute of the University of Genoa, Italy, Sept. 1–10, 1950. The course will be given in both Italian and French. Application for enrollment should be made before June to the Secretary, Dr. P. Amisano, Istituto Radiologia dell' Universita, Ospedale S. Martino, Genoa, Italy.

RECOMMENDATION OF AMERICAN ACADEMY OF PEDIATRICS ON RADIOACTIVE ISOTOPES

On Nov. 14, 1949, the Executive Board of the American Academy of Pediatrics approved the following recommendation of its Special Committee for the Study of Radiation Effects in Childhood (Chairman: Harold W. Dargeon, M.D.) concerning the use of radioactive isotopes:

> "No Research Study with radioactive isotopes should be undertaken on pregnant women unless:
> (1) It cannot first be done on animals.
> (2) The study is approved by the Committee for Human Use of Radioactive Isotopes of the Atomic Energy Commission."

The recommendation was made because of the ready availability of certain radioactive isotopes at present and the fact that it is now possible for an individual obtaining isotopes from a cyclotron to be the sole judge of how these substances are to be used.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

BETEKENIS EN BEPALING VAN DE SKELETLEEFTIJD. By Dr. BERNARD SPEIJER, Rotterdam, Holland. A volume of 154 pages, with 210 illustrations. With a summary and legends in both English and French. Published by Eduard Ijdo N.V., Leiden, 1950.

AN INDEX OF NOMOGRAMS. Compiled and edited by DOUGLAS P. ADAMS, Associate Professor of Graphics, Massachusetts Institute of Technology. A volume of 174 pages. Published jointly by The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York, 1950. Price $4.00.

Book Reviews

BRONCHOGRAPHY. By EELCO HUIZINGA, M.D., and G. J. SMELT, M.D., Department of Oto-Rhino-Laryngology, University of Groningen. A volume of 270 pages, with 146 illustrations. Published by Van Gorcum & Co., Ltd., Assen, Netherlands.

This new work on bronchography, in English, originates from the Department of Oto-Rhino-Laryngology of the University of Groningen, Holland. It is apparent that the radiologist has played a minor role in the studies here presented.

The authors stress the necessity of exact knowledge of the anatomy of the bronchial tree and recommend the terminology adopted by the International Congress of Otolaryngology held in London in 1949. One chapter is devoted to this subject. In another the physiology of the bronchi is discussed, with special reference to changes in their position, the size of the lumen, and peristalsis with the different phases of respiration. Chapter III is largely historical, including a description of the various methods of introducing lipiodol for bronchography and observations on its spread to the smaller bronchi and alveoli.

The normal bronchogram is described in Chapter V, and this is followed by chapters on interpretation and on the bronchographic appearances in the presence of pathologic conditions. Numerous bronchograms are reproduced and cases are reported to illustrate the findings in the presence of neoplasms, inflammatory lesions, and foreign bodies.

Matters of technic are touched upon throughout the work, and a special chapter on this subject concludes the book. The authors believe that fluoroscopic studies during the course of bronchography are unnecessary, nor do they use stereoscopy, which they feel offers no great superiority over the usual plane projections and furthermore requires the use of a special and rather complicated apparatus. They stress the value of oblique views, which, "generally speaking . . . are not given the recognition they certainly merit." Special attention is paid to positioning of the patient in order to obtain adequate filling of the bronchi, and numerous photographs are included in illustration of this feature. The Métras technic, in which catheters are used to canalize the bronchi for segmental bronchography, is described and illustrated.

A list of references to the literature is appended, but the book suffers for want of an index. The bronchograms show good detail but are all positives. Unfortunately they do not always appear in close juxtaposition to the descriptive material, but with a large number of illustrations this is, of course, unavoidable. The book is well bound and attractively printed. It is a useful addition to the literature on bronchography.

CAROTID ANGIOGRAPHY, WITH SPECIAL REFERENCE TO THE DIAGNOSIS OF CEREBRAL GLIOMAS. By A. TORKILDSEN, Oslo. From the Department of Neurology (Chief, Prof. G. H. Monrad-Krohn) and the Neurosurgical Subsection (Surgeon in Charge, A. Torkildsen) of Rikshospitalet, Oslo. Acta Psychiatrica et Neurologica, Supplementum No. 55. A volume of 168 pages, with 63 illustrations. Published by Ejnar Munksgaard, Copenhagen, 1949.

This monograph, published as a supplement to *Acta Psychiatrica et Neurologica*, includes a detailed presentation of a technic for routine carotid angiography, utilizing but slightly modified x-ray equipment, and continues with a discussion of the angiographic findings in 127 cases of proved cerebral glioma. The procedure has been so successful that the author now prefers it to air studies, using it routinely, and in many instances as an outpatient measure. In addition to proper localization of the growth for the best surgical approach, his goal now includes the differentiation of the "benign" from the "malignant" gliomas.

Egas Moniz with Almeida Lima obtained the first carotid arteriogram in 1926, using strontium bromide. Later (1927) sodium iodide, then (1931) thorotrast became popular. Torkildsen introduced routine angiography into his clinic in 1938, selecting 35 per cent perabrodil (diodrast) as a contrast medium. He claims priority in the routine use of this material. The high points of his method are as follows. With the patient under light sedation, and with local anesthesia, the carotid artery is punctured percutaneously just above the bifurcation. The patient, positioned for the exposure, receives

10 c.c. of perabrodil within three seconds through a large-bore needle. A switch attached to the plunger of the syringe activates the tube when 7 c.c. has been injected. An automatic timer exposes a second film four seconds later. Cassettes are changed manually. By additional injections, various views and repeat films may be obtained as desired. No serious complications have resulted from the procedure.

Excluding growths not amenable to accurate carotid angiographic diagnosis, such as cerebellar tumors, midline growths near the third ventricle, and pineal tumors, Torkildsen selected 127 instances of glioma from a series of 1,510 studies. Topographically these included 31 frontal, 33 parietal, 39 temporal, 13 occipital, and 11 central gliomas. Interpretation of the vascular displacement as it occurs in these regions is well elucidated. Angiography proved superior to pneumographic studies both in demonstration of the tumor and in accuracy of localization. Moreover, by inspection of the vascular pattern the author made a correct preoperative diagnosis of 34 out of 56 astrocytomas and 36 out of 55 glioblastomas, recognizing them pathologically as such. The section on differential diagnosis of all space-occupying lesions seems rather brief, though that on recognition of the glioblastomas is truly valuable.

As to the physical aspects of the book, the type is clear and readable; the periodical form of binding is insubstantial, but this is not a work which would be used for daily reference. While meaning is at no time seriously compromised, inaccurate spelling (skalp, dissiness), and transposed letters (corups for corpus) are too frequent. Reproductions have sufficient contrast and detail to permit the use of a hand lens in their study. The simplified line drawings of typical vascular displacements are excellent. A bibliography is appended, but there is no index.

BIBLIOGRAPHY OF OCCUPATIONAL MEDICINE. A paper-bound volume of 94 pages. Published by the International Labour Office, Geneva, Switzerland. Available from the Washington Branch of the International Labour Office, 1825 Jefferson Place, Washington 6, D. C. Price $1.00.

In 1923 the International Labour Office initiated the publication of a quarterly "Bibliography of Industrial Hygiene," which was eventually carried through the year 1941. After a lapse of some time this international index of references to major books and articles dealing with the many aspects of industrial health and welfare reappears under the title "Bibliography of Occupational Medicine." The current volume covers the year 1948.

The subjects are classified under the general headings Occupational Medicine, Medicine of Accidents, Industrial Hygiene, Social Medicine and Hygiene, Rehabilitation, Social Insurance, Analytical Methods, and Laboratory Toxicological Studies. Twenty-three references are given under the subheading Radioactive Substances. An author index and a subject index are furnished.

The references included are rigorously confined to those in respect of which complete information is available. Titles are given in the original language (except in those cases where a secondary source is indicated), and where that language is English, French, German, Italian or Spanish, no translation is provided. Titles in other languages are followed by a translation into English and French.

The usefulness of such a bibliography to those interested in industrial medicine is obvious.

AKTUELLE PROBLEME DER PATHOLOGIE UND THERAPIE. Edited by PROFESSOR DR. H. HOLTHUSEN, Hamburg. A volume of 248 pages, with 49 illustrations. Published by Georg Thieme, Stuttgart, 1949. Distributed by Grune & Stratton, Inc., New York.

On Oct. 30, 1948, the General Hospital of St. George in Hamburg, Germany, commemorated the 125th anniversary of its opening. For this occasion a series of 23 papers dealing with a variety of medical subjects was prepared under the editorship of the chief of the medical staff, H. Holthusen, and they are presented in this volume.

Two of the contributions are of special interest to the radiologist. One, a paper by Gauwerky and Lindemann, deals with the roentgenologic study of the parotid gland after injection of a contrast medium (40 per cent Jodipin oil). The value of sialography in the diagnosis of tumors of the parotid, fibrosis following irradiation, inflammatory processes, and in the differential diagnosis of swellings of the parotid of unknown origin, is briefly discussed. In the other paper Holthusen and Gauwerky analyze the results obtained by irradiation in gynecological carcinoma. They point out that the role of radiation therapy in female genital carcinoma is not the same in all locations. Carcinoma of the ovary is still largely a surgical problem, and the same probably holds true for carcinoma of the vulva. In the latter, electrocoagulation should be given serious consideration. In carcinoma of the fundus, it is generally conceded that hysterectomy offers better permanent results than irradiation alone, while in carcinoma of the cervix, the vagina, and the female urethra, radiation therapy is predominant. The authors' survival rate in carcinoma of the cervix is certainly at least as good as that claimed for surgical procedures, and in carcinoma of the fundus irradiation may approach the five-year surgical survival rate, especially since the introduction of the "packing technic" developed by Heyman at the Radiumhemmet.

Holthusen's address given at the memorial meeting is reprinted in a supplement. He briefly reviews the history of the institution, points to the destruction caused by the war, and expresses the hope that a lasting peace will make possible not only restoration but improvement of the hospital's service to its patients.

IN MEMORIAM

Henri Coutard, M.D.

1876-1950

Henri Coutard was born in Marolles-les-Braux (Sarthe, France), on April 27, 1876; he went to school in Caen and was graduated from the University of Paris in 1902. A victim of pulmonary tuberculosis, he moved to the mountain region of Jura, where he practised medicine for several years, recovered his health, and became an ardent alpinist. He returned to Paris to undertake his first research work with the newly discovered radium at the Laboratoire d'Essais of Gif, in the Parisian *banlieu*, and in 1912 he published a paper on the therapeutic utilization of radium emanation.

During World War I, Coutard served in one of the first mobile radiological units of modern armies. In 1919 he became associated with Regaud, Lacassagne, Joly, Monod, and Roux-Berger, and with them formed the initial staff of the Radium Institute of the University of Paris. While Regaud and Lacassagne bicycled to distant hospitals to test the technics of radium therapy that were to be widely accepted, Coutard labored in a dark basement, under the few bricks that housed the brains of the Radium Institute. With only a single piece of equipment at his disposal, he studied experimental radiophysiology in lower animals, clinical roentgen therapy, and radiography of the pharynx and larynx of normal individuals and of cancer patients.

Coutard did laboratory work and described elementary radiophysiologic reactions, but it was his results in the treatment of cancer of the pharynx and larynx, briefly presented at the Second International Congress of Radiology (1928), that attracted worldwide attention. He found it necessary to protract the treatments over several weeks and insisted on the importance of daily irradiation; because of this, his technic was nicknamed the "protracted-fractional method." But he also insisted upon the necessity of dosages sufficient to cause severe skin and mucous membrane reactions, upon the advantage of heavily filtered radiations, upon the varied response of variously situated tumors and the necessity of individual adaptations, and upon the lack of a substitute for the clinical observation of patients in order to obtain the desired results. His work became a turning point in modern radiotherapy, establishing the possibilities of roentgen therapy of cancer when it was based on thorough knowledge, not only of physics, but also of radiophysiology and pathology, reinforced by a vast clinical experience in the field of tumors. From all parts of the world, radiotherapists went to Paris to meet him; they were often amazed at his interest in the problem raised rather than in the solution offered, puzzled by his conviction that in explaining a fact we often render it strange to ourselves, and respectful of his dignity, for he had earned it.

In 1937, Coutard came to the United States; he worked with supervoltages at the California Institute of Technology and later studied the possibilities of short (concentrated) treatments on carcinoma of the larynx, at the Chicago Tumor Institute. In 1941 he became Director of Research of the Penrose Tumor Clinic, accepting the invitation of the El Pomar Foundation to continue his work, with the devoted cooperation of the Sisters of Charity, in the calm, silence and beauty of the mountains of Colorado Springs. A sensitive man and an admirer of nature, he took frequent hikes into the Rockies, remembering the enthusiasm of his youth and the persistent desire to climb another crest, never wanting to be, always aspiring to become.

In 1949, aged 73, and needing a rest, Coutard returned to France, where he published a monograph containing his reminiscences, his hypothetic concepts of the effects of radiations on tumors, and his belief in the effectiveness of very small doses of radiations.[1] On March 16, 1950, after three months of infirmity due to a cerebral hemorrhage, he died in Le Mans, his boyhood home.

Coutard was an individualist with austerity, an habitual skeptic, possessed of a mystic respect for the unknown and a taste for the impossible; he feared the crippling consequences of contemplation of the accomplished task, and thought of consistency as a distortion of character. He was subject to that disharmony of intellectual aspirations and emotions which is at the basis of genius.

J. A. DEL REGATO, M.D.

[1] Coutard, H.: Aperçus roentgenthérapiques relatifs à divers modes d'involution cancéreuse et méthodes de protection, Paris, France, G. Doin & Cie, 1949.

Henri Coutard, M.D.
1876–1950

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Philadelphia, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37, Ill.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M. D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Robert L. Ayers, M.D., 726 4th St., Marysville. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. F. Reynolds, M.D., University Hospital, San Francisco 22. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John J. McGuire, M.D., 1117 N. Palafox, Pensacola. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, David Kirsh, M.D., 712 duPont Bldg., Miami 32. Meets monthly, last Wednesday, 8:00 P.M.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ted F. Leigh, M.D., Emory University Hospital. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Drane, M.D., De Renne Apartments, Savannah. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY, *Secretary*, John H. Gilmore, M.D., 720 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Harold L. Shinall, M.D., St. Joseph's Hospital, Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*. William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, George Belanger, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, H. R. Senturia, M.D., Pasteur Medical Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John E. Downing, M.D., 816 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at the Harvard Club.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Vaughn Winchell, M.D., 40 Meigs St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D , Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 807 Broadway, Fargo.

Ohio

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, E. C. Elsey, M.D. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Selma Hyman, M.D., University of Oregon Medical School, Portland. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., 1930 Chestnut St, Philadelphia 9. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets second Wednesday of each month at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during Annual Session of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frere, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Walker, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Two-day meeting in May; one-day with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D. Associate Honorary Secretary-Treasurer, Jean Bouchard, M.D. *Central Office*, 1535 Sherbrooke St., West, Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Arteriography in Cerebral Vascular Accidents. I. S. Wechsler and S. W. Gross. J. A. M. A. **139:** 502–505, Feb. 19, 1949.

Encouraged by the results of cerebral arteriography in cases of vascular anomalies, the authors employed it, also, in instances of cerebral vascular accidents to determine more accurately the nature and location of the lesion and whether surgical treatment could be instituted. It is their opinion that the procedure is safe and that, if the diagnosis of hemorrhage is made, trephinement and attempted evacuation of the clot are indicated. Furthermore, differentiation between thrombosis and hemorrhage is of value when choosing between anticoagulant therapy and trephinement. Early arteriography is advocated.

The report is based on 10 cases. Six patients had intracerebral hemorrhage, 3 had cerebral thrombosis, and 1 had thrombosis of the internal carotid in the neck. The diagnosis of intracerebral hemorrhage is indicated by distortion of vascular pattern by the mass of the clot. Distortion may be produced by tumor as well, but displacement of the vessels due to that cause can be differentiated with fair assurance.

The patients with remediable hemorrhage of the brain were comparatively young (21 to 50 years), all in good health previously.

Four roentgenograms.

D. J. Sayles, M.D.
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Experimental Study of Contrast Media for Cerebral Angiography with Reference to Possible Injurious Effects on the Cerebral Blood Vessels. Tore Broman and Olle Olsson. Acta radiol. **31:** 321–334, April 30, 1949.

The present investigation is a continuation of earlier tests to determine the extent and severity of cerebral vessel injury after injection of contrast media of the diodrast group (Acta radiol. **30:** 326, 1948. Abst. in Radiology **53:** 624, 1949), in which it was found that the concentration of the medium and the application time were the important factors. Six aqueous media were tested; of these, only diodrast is in common use in America.

The authors' technic consisted of injecting trypan blue into rabbits previously injected with the various media. If any change in the permeability of the vessel wall was present, the trypan blue stained the brain tissue, and frozen sections were made of this area to search for more serious damage. It was found that convulsions occurred only in the presence of an associated vascular disorder. Respiratory paralysis, although frequently transient, was usually associated with a vascular disorder. The more severe damage consisted of cerebral edema, punctate hemorrhages, and stasis. The hemorrhages do not occur until the vessels have been damaged for several hours.

Umbradil and umbradil-methyl-glucamine in 35 per cent solution produced no injury after applications lasting as long as forty seconds; but 50 per cent solutions of the latter caused injurious effects after an application time of only ten seconds. Thirty-five per cent diodrast produced considerable injury and a 70 per cent solution of this medium caused marked changes after an application time of only one second. Umbradil forte (50 per cent) was the best of the more concentrated solutions, although a change in permeability was seen with this dye, without further injury.

The authors have shown that the changes were not due to osmotic pressure, but believe them to be direct chemotoxic effects.

Two illustrations; 3 tables.

Matthew O. Marks, M.D.
Cleveland City Hospital

Roentgen Findings in Intracranial Mass Lesions. J. George Teplick and Philip Dorsey. Am. J. Roentgenol. **61:** 762–774, June 1949.

The findings on routine conventional skull films provided localization of 61 of 123 proved intracranial mass lesions, or 49.6 per cent. An additional 25 per cent were localized when routine films were supplemented by air studies. In approximately 15 per cent of the series mass lesions were suspected but not localized from the plain films, and in 35 per cent, the films were completely negative. The series included over twenty different histopathologic types, with gliomas and meningioma predominating. Fifty per cent of the lesions were in the cerebral hemispheres, and 18 per cent were subtentorial.

The roentgen changes used for diagnostic purposes are tabulated in the following order of frequency: sellar erosions and deformities (15.5%); pineal displacement (13.8%); demineralization of dorsum sellae (12.2%); calcifications (12.2%); widening of sutures (11.4%); increased digital markings (10.6%); sphenoidal fissure changes (8.1%); table changes (7.3%); orbital bone changes (5.7%); enlarged internal auditory meatus (4.8%); petrous pyramid erosions (4.05%); choroid displacement (1.6%); displaced falx (0.8%); and increased table vascularity (0.8%). Only 1 of 25 cases of meningioma showed the characteristic spicule formation in the skull tables. Lateral displacement of the pineal calcified body was found to be more readily and accurately determined than displacement in the sagittal plane, and only one instance was encountered where a definite backward displacement occurred without lateral deviation (basisphenoid meningioma).

Twenty-five roentgenograms; 6 tables.

J. A. Campbell, M.D.
Indiana University

Associated Facial and Intracranial Hemangiomas. Daniel F. Downing and Marshall B. Kreidberg. J. Pediat. **34:** 564–573, May 1949.

The concomitant occurrence of facial and intracranial hemangiomas has been commonly called the Sturge-Weber syndrome. Five clinical features of this condition are: nevus over the trigeminal area, jacksonian seizures, intracerebral calcification, psychic disturbances, and ocular abnormalities. These associated hemangiomas are felt to be due to a common mesodermal defect in the vascular bed. When a child is seen with a trigeminal nevus, an effort should be made to determine the presence of an intracranial angioma by x-ray examination of the skull, electroencephalography, pneumoencephalography, and cerebral angiography. Surgical intervention in a proved case may prevent serious sequelae.

A case is described in which four of the five clinical features noted above were present. In addition, the pneumoencephalogram showed slight dilatation of the entire ventricular system. An electroencephalogram showed definite focal slow wave activity occurring in the right hemisphere, most marked in the motor and occipital regions and suggesting a localized lesion. A right carotid cerebral angiogram visualized the middle cerebral artery well but not the anterior cerebral. No abnormality of the opacified vessels was seen. Although the patient, a two-year-old child, was not operated upon, it was felt that there was satisfactory evidence for the diagnosis of intracranial hemangioma associated with the hemangioma on the forehead.

Two roentgenograms. PAUL W. ROMAN, M.D.
Baltimore, Md.

Osteoporosis Circumscripta Cranii (Osteoporosis Circumscripta of Schüller). F. Lepennetier and R. Grain. J. de radiol. et. d'électrol. **30:** 282–286, 1949. (In French)

Osteoporosis circumscripta cranii is characterized by sharply circumscribed areas of osteoporosis involving both the inner and outer tables of the skull, usually bilaterally, and presenting large irregularly shaped areas of demineralization in a pattern reminiscent of the contour of a geographical map. Schüller in 1929 described 5 cases (Med. Klin. **25:** 631, 1929) and until 1937 only 47 cases had been reported. The authors on reviewing all their skull roentgenograms over a long period of years have added 5 more examples.

All of the reporting authors describe large decalcified zones of homogeneous texture with rather sharp borders, and without bone reaction at the margins of the lesion. The diploe is not involved and there is no depression or bulging of the skull. Usually the lesion progresses slowly over the years so that decalcified zones appearing in the frontal and occipital areas may become confluent. Clinically there are few if any relevant symptoms except persistent headaches in a small proportion of cases. Palpation or pressure reveals no information.

In most of the reported cases definite evidence of Paget's disease was found in the long bones, the spine, and the pelvis. Quite frequently, also, small cotton-wool opacities were seen in the skull associated with the osteoporosis. Many authors designate the osteoporosis as an early or atypical manifestation of Paget's disease in the skull. The serological alterations of Paget's disease also appear in most cases of osteoporosis circumscripta. In 7 of the reported cases primary malignant tumors of the maxilla were present without evidence of Paget's disease.

The differential diagnosis includes all the conditions which produce bony translucencies in the skull, but they are usually distinguished fairly easily.

Six roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

Cranial Findings in Sjögren's Syndrome. Franco Fossati. Radiol. med. (Milan) **35:** 476–482, June 1949. (In Italian)

The author has observed 5 cases of Sjögren's syndrome with the typical decrease of lacrimal and salivary secretion. In all these patients radiographs of the skull showed hyperostosis frontalis interna.

Five roentgenograms. CESARE GIANTURCO, M.D.
Urbana, Ill.

Radiologic Study of Mastoid Bone in Infants in Conjunction with Anatomic and Pathologic Investigations. Henry G. Koiransky, Irving K. Ettman, and Edward L. White. New York State J. M. **49:** 1291–1292, June 1, 1949.

Roentgenologic studies of the mastoid bones of infants up to one year of age were made with a view to determining the earliest age that one can visualize the pneumatization within the mastoid process. The first 50 subjects in this series were newborn infants and infants under one month of age. In this group the authors were able to note the beginning of pneumatization of the mastoid bone on the roentgenogram in 4 cases. In these infants development was more advanced and the body weights were greater than the others of the group. This observation together with those of the remaining children—one month to one year of age—led to the conclusion that the formation of mastoid cells is dependent on physical development rather than on the chronological age of the individual and that the mastoid bone and cells can be visualized at a much earlier age than previously considered possible. Since the presence of pneumatization may be a factor in early dissemination of infections in this region, x-ray examination can be of aid to the clinician.

One drawing.

A Röntgen-Ray Microspectrographic Investigation of the Inflammatory Destruction of the Mastoid Bone. Arne Engström, C. A. Hamberger, and Sölve Welin. Brit. J. Radiol. **22:** 309–324, June 1949.

This article reports a beautiful and carefully done investigation to determine what pathological changes account for the radiographic evidence of "calcium absorption" in mastoiditis. The results indicate that if decreased density is observed in the mastoid and the cell partitions are thicker than 0.3 mm., there is probable involvement of the bone. If the cell walls are less than 0.3 mm. (which is usually the case in children), a decrease in contrast may not be due to bony involvement but may be the result of swollen membrane and intracellular exudate.

Twenty-two illustrations, including 13 microradiograms; 2 tables. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Benign Cysts of the Paranasal Sinuses. Harold F. Schuknecht and John R. Lindsay. Arch. Otolaryng. **49:** 609–630, June 1949.

Benign cysts of the paranasal sinuses are of two types: those originating from the sinus mucosa and those invading the maxillary sinuses from the teeth. The authors offer the following classification:

A. Cysts arising from the sinus mucosa
   1. Non-secreting cysts
   2. Secreting cysts
      (*a*) Retention cyst
      (*b*) Mucocele
B. Odontogenic cysts
   1. Follicular cysts (dentigerous)
   2. Radicular (root) cysts

The *non-secreting cysts* are accumulations of exudate in the subepithelial loose connective tissue of the maxillary sinuses. They usually give symptoms only when they are large, producing local symptoms as well as fatigue, lassitude, and headache. On the roent-

genogram the non-secreting cyst appears as a dome-shaped shadow arising from the floor of the antrum. There is no alteration in the bony wall of the sinus.

The *retention cyst* is due to blockage of the duct of a tubo-acinose gland of the sinus mucosa, resulting in cystic dilatation of the gland by accumulating secretions. This cyst is apparently not evident either clinically or roentgenologically.

A *mucocele* is an accumulation of the products of secretion, desquamation, and inflammation within a paranasal sinus, with distention of the sinus walls. Histologic examination of the wall of a mucocele reveals that it is the distended mucoperiosteal lining of the sinus throughout. The usual site is the frontal or ethmoid sinus. The development of a mucocele is usually slowly progressive. Roentgen findings depend on the size, location, and amount of deformity produced. The contents of the cyst make the cavity less radiolucent than the normal air-filled sinus. Pressure erosion of the bony walls due to the expansion of the cyst may, however, more than offset this added density.

The *follicular cyst* is derived from the enamel organ epithelium and usually contains the crown of a tooth in its wall. There are often no symptoms until the cyst is so large as to cause deformity. The typical roentgen picture is that of a rounded area of destruction of bone with smooth borders, containing a tooth.

The *radicular cyst* develops at the root of a tooth, probably from central necrosis of an apical granuloma. Swelling and tenderness are usually present in the involved area. Dental roentgenograms reveal the round area of bone destruction in the alveolar process, usually around the root of a tooth. When the antrum is involved, roentgenograms of the sinuses show a dense homogeneous shadow bulging up from the floor.

Twelve roentgenograms; 14 photomicrographs; 6 photographs.

PAUL W. ROMAN, M.D.
Baltimore, Md.

A Roentgen and Clinical Study of Nasopharyngeal Malignancies (Lympho-epithelioma and Transitional Cell Carcinoma). George J. Baylin, Robert J. Reeves, and Herbert D. Kerman. South M. J. **42:** 467–475, June 1949.

Lympho-epithelioma and transitional-cell carcinoma of the nasopharynx are usually silent tumors, leading to symptoms only after they have impinged on neighboring structures or spread to adjacent regions. For their proper management, the radiologist must have a proper understanding of the anatomy of the nasopharynx both in regard to early diagnosis by direct visualization or characteristic roentgen findings and the application of proper radiotherapy.

The authors discuss he anatomy of the nasopharynx and clearly outline the modes of spread, which result in a varied pattern of neurologic, ocular, nasal, lymphatic, and auditory complaints. It is these complaints which are usually responsible for the discovery of the lesion.

These tumors may affect any age group. In the authors' series of 32 cases the range was from six to seventy-nine years, with the majority of cases appearing in adolescence and in the sixth decade. The most common complaint at the initial hospital visit was enlarged nodes in the neck. The most significant roentgen studies are stereoscopic basal views of the skull. The most common findings are destruction of the basi-occiput, involvement of the basal foramina manifest either as enlargement or complete destruction, and abnormalities of the petrous tip. The incidence of soft-tissue changes in the basal airway is high.

The radiologist's responsibility in malignant nasopharyngeal disease is a heavy one, since many patients, despite clinical and roentgen evidence of metastasis, can be greatly benefited by properly administered therapy.

Twenty-four roentgenograms; 1 drawing; 2 tables.

ROBERT H. LEAMING, M.D.
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THE CHEST

Segmental and Lobular Physiology and Pathology of the Lung. Edward D. Churchill. J. Thoracic Surg. **18:** 279–293, June 1949.

The author points out that the structure of the lung is designed to maintain a *space-occupying* function as well as a respiratory function. Even though the respiratory function of a lung segment is destroyed, it may continue to contain air and occupy space as a result of *collateral interalveolar air drift*. It is of considerable practical importance to recognize that air-containing lung tissue, as visualized either on the roentgenogram or in the surgical specimen, is not necessarily healthy, functioning lung tissue. In this respect, lung tissue differs from other organs, in which atrophy follows obliteration of ductal systems or vascular channels. In similar fashion, capillary blood drift will occur in lung segments whose pulmonary artery supply has been cut off by means of small emboli.

As illustrations, the author presents observations on several resected lobes with one segment affected by bronchiectasis and an adjacent one by *obliterative bronchitis*, in which the bronchial branches were demonstrated by lipiodol to resemble a "leafless tree." The alveoli in such a segment contain air, but they get it by means of collateral interalveolar air drift and not through normal direct respiration.

Seven illustrations, including 3 roentgenograms.

HAROLD O. PETERSON, M.D.
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Discretion in the Use of Bronchography (Editorial). Richard H. Overholt and Beatty H. Ramsey. Dis. of Chest **15:** 745, June 1949.

Writing editorially, the authors point out the disadvantages of residual oil in the lungs following bronchography. The oil is not completely eliminated for at least two weeks on the average. While in the lungs, it is dense to x-rays, incites an inflammatory reaction, and obscures underlying pathological processes. Superimposed densities from this cause may confuse the picture in the presence of disease processes subject to change and, if there is severe dyspnea or low respiratory capacity, the added burden of an oil pneumonitis may result in pulmonary insufficiency. Limitation of respiratory function may greatly increase the risk of surgery or cause serious delay when prompt intervention is indicated.

To illustrate these dangers, the authors cite the case of a man with a carcinoma of the right main stem bronchus demonstrated by bronchoscopy. Bronchography had been done prior to bronchoscopic examination. Not only did this fail to establish either a positive diagnosis or the possibility of resection, but excess

oil spilled into the left lung and obscured evidence of spread of the disease to that side. Dyspnea was aggravated, and surgery was delayed.

The increasing use of iodized oil in the diagnosis of pulmonary diseases should be tempered with caution and discrimination. It should not be used unless it can be said that (1) its use will not obscure important changes in the pulmonary parenchyma, (2) it will not seriously aggravate a pulmonary insufficiency, and (3) it will not prove a complicating factor in therapy.

HENRY K. TAYLOR, M.D.
New York, N. Y.

A Useful Procedure in Tomographic Exploration of the Bronchi. René Jeanneret, François Kovats, and François Nicod. J. franç. de méd. et chir. thorac. **3:** 116–130, 1949. (In French)

Radiologic exploration of the bronchial tree is not easy. In order to be useful, the radiologic examination must determine three essential facts: the state of the bronchial wall; the modifications of dimension and form of the lumen of the bronchus; and the exact localization in space of the bronchial alteration.

Bronchography with opaque oil yields excellent images and is the basic method in the study of bronchiectasis. It is not always indicated in pulmonary tuberculosis; it is not invariably harmless and it is less often required since tomography has come into current use.

The incidence of the planes "cut" in tomography is such that the principal trunks of the bronchial tree are not seen all together at the same time. Also, interpretation of a single bronchial lesion may be troublesome. At right angles a bronchial stenosis may appear as a circle; in the longitudinal plane the image is a set of parallel lines. In other planes the image would be elliptical. Thus, the ideal plane to demonstrate the stenosis is the longitudinal plane parallel with the axis of the bronchial tube.

The "principal plane of the bronchi" is described as the plane in which the trachea, carina, and main bronchial trunks may be visualized, much as in bronchoscopy. Secondary bronchi may be visualized in planes anterior and posterior to the principal plane. The most adequate position to demonstrate this plane is an apical lordotic position in dorsal decubitus. The spinous processes of the seventh cervical and second thoracic vertebrae serve as the superior and inferior points of fixation.

The use of such a specific position aids in systematically determining the location of a bronchial lesion and helps to confirm the bronchoscopic examination.

Seven roentgenograms; 12 drawings.

CHAS. NICE, M.D.
University of Minnesota

The Preoperative Scout Film of the Chest. Franklin B. Wilkins, Frank Isaac, and Richard E. Ottoman. West. J. Surg. **57:** 229–234, June 1949.

Three case histories with roentgenograms are presented to illustrate the importance of a preoperative scout film of the chest in acute abdominal emergencies. These serve to emphasize the following points: (1) that demonstration of left pneumothorax or mediastinal emphysema in a patient with signs and symptoms of ruptured duodenal ulcer may indicate a rupture of the esophagus; (2) that deformity of the diaphragm on the left with an irregular pulmonary density just above the dome and an acute abdominal history is suggestive of strangulated diaphragmatic hernia; (3) that the chest findings may give the clue to the diagnosis of a cardiac condition, *e.g.*, pericarditis with pericardial effusion, simulating intra-abdominal disease.

The value of the preoperative chest film in elective abdominal surgery is demonstrated by 3 additional cases, in which the discovery of Boeck's sarcoid, diaphragmatic hernia, and pulmonary metastases altered, or should have altered, the subsequent management.

Preoperative films of the chest are also useful in establishing a "normal" for comparison with postoperative films.

Ten roentgenograms. GABRIEL WHITEMAN, M.D.
University of Louisville

Suppurative Disease of the Lungs. Fred R. Harper, William B. Condon, and William H. Wierman. Arch. Surg. **58:** 819–831, June 1949.

Suppurative disease of the lungs includes bronchiectasis, lung abscess, and infected cyst, all of these are attributable to partial bronchial obstruction and added infection. Early vigorous treatment of these is essential, since changes are completely reversible at the beginning but become irreversible if allowed to remain a few weeks. Progress should be followed by weekly roentgenograms; failure of any one of these to show definite improvement is evidence that the treatment is inadequate.

Irremovable obstruction or irreversible changes in the lung require resection of the diseased portion. The authors, in general, favor lobectomy to segmental resection except in the case of the lingula. With modern technics this is no more hazardous than removal of other diseased organs, and should be undertaken as soon as a diagnosis has been established.

Nine roentgenograms; 5 tables.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Apical Bronchiectasis. P. Pruvost, Teyssier, Brincourt, and Mlle. Gosset. J. franç. de méd. et chir. thorac. **3:** 101–115, 1949. (In French)

Apical bronchiectasis is often not recognized, and often not sought, in studying pulmonary disease. By careful lipiodol studies the cystic dilatation of the upper lobe bronchi may be demonstrated. At times tomography aids in revealing the condition.

Symptoms may include dry cough and even occasional hemoptysis. Sometimes a history of tuberculosis is obtained. In most cases, however, tubercle bacilli are not demonstrated. This does not rule out a tuberculous etiology, however, as the tuberculous lesion may be healed, leaving bronchial scarring to initiate the apical bronchiectasis.

Sixteen roentgenograms. CHAS. NICE, M.D.
University of Minnesota

Cystic Disease of the Lung. J. E. Strode. J. Thoracic Surg. **18:** 404–416, June 1949.

The author discusses the etiology, symptoms, diagnosis, and treatment of cystic disease of the lung before going on to present the histories of four cases in his experience, all proved by surgical intervention. He follows Moersch and Clagett (J. Thoracic Surg. **16:** 179, 1947. Abst. in Radiology **50:** 261, 1948) in classifying cysts as of two types—bronchogenic and alveolar, depending on the histology of the cyst lining.

Cystic disease may be asymptomatic, in which case it is an incidental x-ray finding, if it is discovered at all. Symptoms may consist of respiratory embarrassment due to cysts of huge size, to hemorrhage, or to recurrent infections—pneumonia, empyema, abscess, or bronchiectasis. Cystic disease may masquerade as atypical tuberculosis, lung abscess, pneumothorax, empyema, or even carcinoma.

The results from surgery of this disease are usually gratifying.

Sixteen illustrations, including 9 roentgenograms.

HAROLD O. PETERSON, M.D.
University of Minnesota

Eosinophilic Xanthomatous Granuloma with Honeycomb Lungs. Thomas Parkinson. Brit. M. J. **1:** 1029–1030, June 11, 1949.

The author presents the history of a 56-year-old man with diabetes insipidus, a solitary eosinophilic granuloma of the femur, and generalized reticulation of both lung fields forming small annular shadows about 0.5 cm. in diameter. The pulmonary manifestations were due to small cystic areas in the lungs, confirmed by tomography. The lesion in the femur was biopsied and treated by roentgen irradiation, with complete relief of pain after the third day of treatment. Pitressin tannate injections controlled the diabetes insipidus. X-ray therapy was given to the pituitary fossa and lungs, but dyspnea was not relieved nor was the diabetes insipidus alleviated.

The author discusses eosinophilic granuloma of bone, Hand-Schüller-Christian disease, and Letterer-Siwe's disease, with references to the many articles dealing with each of these conditions. He concludes that the name "eosinophilic xanthomatous granuloma" should be used to include them all.

Two roentgenograms. D. R. BRYANT, M.D.
The Henry Ford Hospital

A Correlated Study of Tuberculin, Histoplasmin and Coccidioidin Sensitivities with Pulmonary Calcifications in the Rocky Mountain Area. W. K. Absher and F. Cline, Jr. Am. Rev. Tuberc. **59:** 643–649, June 1949.

In an attempt to find the cause of pulmonary calcifications in patients in the Rocky Mountain area, where histoplasmin sensitivity is supposedly uncommon, a survey was made of a group of 1,000 war veterans and Veterans Administration personnel. Tuberculin (0.0005 mg. PPD), histoplasmin (1:100) and coccidioidin (1:100) skin tests were made on each subject, and a chest roentgenogram was obtained.

Of the 1,000 persons tested, 55.8 per cent reacted to tuberculin, 22.6 per cent to histoplasmin, and 6.5 per cent to coccidioidin. Multiple pulmonary calcifications (10 or more) were present in 14 of 404 tuberculin reactors, in 8 of 73 histoplasmin reactors, and in 16 of 110 subjects reacting to both antigens. Among 348 persons reacting negatively to all antigens, 24 instances of hilar and/or parenchymal calcifications were noted; only one patient of this group showed multiple calcifications.

Three hundred and twenty-two of the 1,000 persons studied were classified as natives of Colorado, and 40 or 12.4 per cent of these reacted to histoplasmin. Twenty-seven of this number, however, gave a history of residence in an endemic area for varying periods, leaving only 4 per cent of the histoplasmin reactors unexplained on a geographic basis. This is held to support the previous reports of U. S. Public Health Service investigators that the Rocky Mountain Area is not endemic for histoplasmosis of the so-called benign type. No diagnostic pattern or distribution differences of pulmonary calcifications could be determined.

Two roentgenograms; 2 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Pulmonary Infiltration Associated with Sensitivity to Histoplasmin. Report of a Case. Daniel W. Zahn. Am. Rev. Tuberc. **59:** 636–642, June 1949.

It has now been established that pulmonary infiltrations simulating those of tuberculosis may be associated with histoplasmin sensitivity. The author reports a case in a patient who had lived in Ohio for most of his twenty-six years. Pulmonary infiltrative disease was first discovered on routine pre-employment examination in October 1946, but the patient was not hospitalized until July 1947. The original films showed a minimal infiltrate in the right first interspace which appeared quite soft and active, and a more fibrous-appearing lesion in the left first interspace. Roentgenograms obtained on hospital admission showed regression of the pulmonary lesions and a tendency to fibrosis. Extensive studies failed to reveal a causative organism, but the patient was sensitive to histoplasmin in 1:100 dilution and anergic to tuberculin; the reaction to coccidioidin was also negative.

The author believes that the pulmonary lesions in this case were due to *Histoplasma capsulatum* and that they represent a relatively benign form of the disease. He warns, however, that such patients should be closely observed and followed with serial roentgenograms and clinical laboratory studies.

Four roentgenograms. JOHN H. JUHL, M.D.
University of Wisconsin

Coccidioidomycosis. Case Studies in Children. Robert Cohen. Arch. Pediat. **66:** 241–265, June 1949.

The author reports 10 cases of coccidioidomycosis in children, each identified with a particular form of coccidioidomycosis. They are briefly, as follows:

1. *Pulmonary Coccidioidomycosis:* Female, 9 years. This is the primary lesion most commonly found on following up routine positive coccidioidin skin tests.

2. *Erythema Nodosum:* Female, 7 years. The lesions were limited to the skin over both tibiae.

3. *Pleurisy with Effusion:* Male, 6 years. Extensive laboratory studies differentiated the lesion from tuberculous pleurisy with effusion.

4. *Coccidioidal Infection of the Lungs Superimposed on Pulmonary Tuberculosis:* Female, 4½ years. The course of the lesion would seem to indicate clearly the combination of a slowly resolving childhood pulmonary tuberculosis with a typical primary pulmonary coccidioidal infection.

5. *Lobar Pneumonia and Bronchopneumonia of Pertussis, and Coccidioides with Abscess:* Male, 17 months. The chest film was typical of miliary tuberculosis, but tuberculin skin tests were negative. While no case has ever been reported of miliary pulmonary coccidioides in the pediatric field, the common complications of pertussis associated with a positive coccidioidin test and serology lead the author to consider this a

coccidioidal infection superimposed on the pneumonias. The patient recovered.

6. *Spina Ventosa (Dactylitis) of Coccidioidal Etiology:* Female, 6 months. Roentgenograms revealed destruction of the middle phalanx of the ring finger typical of either tuberculous or coccidioidal dactylitis. The Mantoux test was negative and the coccidioidal skin test strongly positive.

7. *Coccidioidal Meningitis:* Male, 3½ years. The coccidioides skin test was strongly positive, while the Mantoux test was negative. There were no organisms demonstrated on smear. The complement-fixation and precipitin tests for coccidioidomycosis were 4 plus.

8. *Disseminated Coccidioides:* Male, 13 months. Lesions were present in the skin, lungs, skull, humerus, clavicle, tibia, and mandible. Smears, cultures, and serology were all positive.

9. *Coccidioidomycosis of the Spine Simulating Pott's Disease:* Female, 12 years. The two diseases could only be separated by laboratory findings.

10. *Scrofulodermic Lesion and Granulomas Associated with Osteomyelitis:* Male, 6 years.

This paper deserves to be read in its entirety. The author is experimenting with Actidione, a new drug, in various types of coccidioidal infection.

Seven roentgenograms; 3 photographs.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

Anthracosilicosis and Its Symptomatic Treatment. Burgess Gordon, Hurley L. Motley, Peter A. Theodos, and Leonard P. Lang. West Virginia M. J. **45:** 125–132, June 1949.

Anthracosilicosis or "coal miners' pneumoconiosis" is the condition of progressive pulmonary fibrosis caused by inhalation of carbon and silica. Dyspnea and disability are the clinical manifestations. Late stages show confluence of large fibrotic nodules and emphysema of varying degree. Tuberculosis may complicate the picture at any stage, while other respiratory infections are frequent.

The amount of fibrosis seen on x-ray examination bears no constant relationship to the degree of disability. The rate of progression of the disease is also variable. With increasing emphysema, more and more cases of right heart strain and failure are seen, but this is not as common as might be expected.

Intermittent positive pressure breathing used two to four times daily was found to be very beneficial. Expectoration was promoted at first and secretions later diminished. The treatment enabled many men to continue employment, though not in dusty jobs. One hundred per cent oxygen with simultaneous administration of epinephrine or other bronchodilator drugs in doses of 0.3 to 0.5 c.c. has provided the most effective symptomatic relief. An abdominal support is often helpful, designed to elevate the diaphragm from the expiration position found with severe emphysema.

Two photographs; 3 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Acute Pneumonitis in a Beryllium Worker. G. Riddell Royston. Brit. M. J. **1:** 1030–1032, June 11, 1949.

A case of acute bronchiolo-alveolitis thought to be due to working in an atmosphere containing beryllium dust is discussed. The most distressing symptoms were cough and dyspnea out of all proportion to the physical findings. The x-ray appearances were of particular interest, showing at first a diffuse soft mottling "almost millet-seed" in some areas. Two weeks later the film seemed to be typical of miliary tuberculosis, and within two months almost complete resolution had occurred without any evidence of fibrosis.

A review of the existing literature on beryllium poisoning follows the case history, with particular attention to pulmonary changes. Other possible causes of pneumonitis in the case reported are discussed and ruled out.

Three roentgenograms. D. R. BRYANT, M.D.
The Henry Ford Hospital

Acute Dermatitis and Pneumonitis in Beryllium Workers: Review of 406 Cases in Eight-Year Period with Follow-up on Recoveries. Joseph M. DeNardi, H. S. Van Ordstrand, and Morris G. Carmody. Ohio State M. J. **45:** 567–575 June 1949.

Since publishing their report on beryllium poisoning in 1945 (J. A. M. A. **129:** 1084, 1945. Abst. in Radiology **47:** 422, 1946), the authors have continued their studies. They now review 406 cases of poisoning seen over an eight-year period, 1940–48, in industrial workers exposed to beryllium and its compounds. Only the acute manifestations are considered.

Dermatologic lesions, occurring in 195 cases, were successfully treated without mortality by removal from further exposure, local applications, and more recently by antihistaminic drugs. Beryllium ulcers, inherently capable of chronicity, were cared for surgically to prevent this complication. Re-exposure usually resulted in recurrence and often respiratory tract involvement. Dermatitis was, therefore, regarded as a rough indication of respiratory tract susceptibility.

As it has been observed that exposure to the metal alone does not produce skin lesions, the authors feel that dermatologic changes result from individual hypersensitivity combined with the irritating effects of the acid radical of the beryllium salts. Beryllium ulcers appeared to result from the entrance of the salt crystals into a cut or abrasion. Subsequent hydrolysis in the tissue fluids yields the acid radical, which produces ulceration in the surrounding tissues.

Respiratory tract involvement, occurring in 211 cases, consisted of relatively benign nasopharyngitis and tracheobronchitis and more serious pneumonitis. This latter manifestation was responsible for 10 deaths among the 90 cases. Relative incidence of and mortality from pneumonitis has decreased in the last five years.

Pneumonitis was thought to result from the irritative effects of beryllium salts within the bronchioles, possibly through histamine-like by-products. The subsequent bronchiolar spasm led to anoxia followed by edema and possibly secondary bacterial invasion.

A fulminating and an insidious type of pneumonitis occurred depending on the degree of exposure. Each invariably followed tracheobronchitis. The roentgenologic manifestations in both types became evident one to three weeks following onset of symptoms. In a typical case they consisted of a particular type of peribronchial haziness and punctate infiltration. These changes were usually confined to the lower lung fields, giving a granular appearance as in pneumoconiosis or pulmonary mycosis. In some, similarity to malignant pulmonary metastasis occurred.

Treatment consisted of hospitalization and symptomatic administration of oxygen. More recently penicillin for secondary bacterial invaders and antihistaminic drugs have been helpful.

Twenty cases of pneumonitis with recovery are reported in detail. In none of these cases were there recurrences, chronic pulmonary manifestations, or disability. The only remaining roentgenologic changes reported consisted of minimal pulmonary fibrosis in 3 cases, one of which showed diaphragmatic adhesions.

Four roentgenograms; 1 table.

R. R. SURRATT, M.D.
Baton Rouge, La.

Tuberculous Spontaneous Pneumothorax. Bernard Hyde and Leroy Hyde. Am. Rev. Tuberc. **59:** 619–623, June 1949.

On the services from which this report comes, spontaneous pneumothorax was found to occur in about 1.4 per cent of cases of pulmonary tuberculosis. The authors studied 40 patients with this complication. Typical symptoms were sudden sharp chest pain and dyspnea of varying degree, with hyperresonance, absence of breath sounds, and diminished movement of the affected side of the chest. Roentgenograms revealed pleural adhesions in 92 per cent and significant pleural effusion in 57 per cent of the cases.

Of the patients studied, 36 had moderately advanced or far advanced tuberculous disease. The two sides were involved with about equal frequency. Four patients had subcutaneous emphysema, a finding previously noted only rarely. The hospital mortality was 28 per cent with an ultimate mortality which was probably much higher.

Spontaneous pneumothorax in pulmonary tuberculosis is due to rupture of the visceral pleura at the site of subpleural caseation, probably most often in the upper third of the thorax. Air enters the pleural space and the lung collapses. In sharp contrast to benign spontaneous pneumothorax was the high incidence of pleural fluid and adhesions in this series, as well as the severity and duration of the illness and the high mortality. In a previous review of 85 cases of benign spontaneous pneumothorax, the authors found no pleural adhesions and fluid above the diaphragm in only 5 per cent (Am. J. M. Sc. **215:** 427, 1948).

One table.

JOHN H. JUHL, M.D.
University of Wisconsin

Transitory Infiltrates in the Lungs with Eosinophilia (Loeffler's Syndrome). A Review with the Report of a Case. Victor F. Woolf and Wilbur J. Gould. Am. Rev. Tuberc. **59:** 679–686, June 1949.

Loeffler's syndrome is now generally recognized to be an allergic reaction occurring in the lungs of a sensitized patient. Eosinophilia ranging from 10 to 66 per cent has been reported associated with pulmonary infiltrates. In some patients the infiltrates disappear and subsequently recur; in some a more prolonged course, from several weeks to several months, has been associated with severe manifestations in other organs. Cases have been reported in the course of or in association with bacterial infections, parasitic infestations, asthma, erythema nodosum, periarteritis nodosa, and various allergic states. The histopathology has been difficult to ascertain because of the benign nature of the disease and the occurrence of complications or associated diseases. Areas of focal or bronchopneumonia are present in which the exudate is largely eosinophilic; infiltrates of these cells are often found in other organs, such as the liver and bone marrow; periarterial eosinophilic infiltration with endarteritis has also been described.

Pulmonary roentgenographic findings vary from lobar consolidation to small round foci; they may simulate tuberculosis and other specific inflammatory diseases. Narrow plate-like densities which extend obliquely caudad and laterally have also been described. These show no predilection for upper or lower lobes, but a fair degree of symmetry on the two sides is often observed.

The authors present a case in which the pulmonary infiltrate simulated bilateral upper lobe tuberculosis but resolved completely in three and a half months. Eosinophilia was present with a high of 14 per cent on admission. The patient had suffered from asthma for six years. An increase in cardiac size and a moderate hypertension occurred during the course of the disease, which led the authors to feel that this case might be one in which there was involvement of extrapulmonary organs.

Six roentgenograms.

JOHN H. JUHL, M.D.
University of Wisconsin

The Pneumonia of Measles. Louis Weinstein and William Franklin. Am. J. M. Sc. **217:** 314–324, March 1949.

The incidence of pneumonia in measles is not easily ascertained. It was reported as 6 per cent in a series of 10,946 measles patients in New York City, many of whom were treated at home, while in a hospital series of 3,720 cases from the same city the figure was 22.6 per cent. The authors found 41 cases which they consider "proved" among 163 patients with measles admitted to the Massachusetts Memorial Hospitals in a period of a year—an incidence of 25.1 per cent. Clear-cut roentgen evidence of pneumonia was present in 21 cases; in the remainder there was adequate clinical or laboratory evidence—cyanosis, respiratory difficulty leukocytosis, etc.—to make the diagnosis definite.

All but 3 of the 41 patients had one or more roentgen examinations of the chest. The findings were as follows:

		Cases
1.	Hilar and peribronchial infiltration	17 (45%)
2.	Patchy infiltration	6 (16%)
3.	Generalized mottled infiltration	4 (10%)
4.	Localized densities with or without 1, 2, or 3	11 (29%)
5.	Density in right upper lobe	3
6.	Density in right middle lobe	2
7.	Density in right lower lobe	1
8.	Density in right lung, lobe not stated	1
9.	Effusion: right pleural cavity	2
10.	Effusion: left pleural cavity	1

The authors found that pulmonary complications were more common in children under five years of age than in older individuals and that most serious bronchopneumonias occurring in rubeola were due to gram-positive bacteria.

Three charts; 6 tables.

JAMES C. KATTERJOHN, M.D.
Indianapolis, Ind.

Pulmonary Syphilis Simulating Extensive Tuberculosis. J. Loubeyre, E. Farkas, and M. Sandra. J. franç. de méd. et chir. thorac. **3:** 169–170, 1949 (In French)

A case of acquired pulmonary syphilis in a 42-year old North African farmer is presented. Six weeks before hospital admission the patient noted a general decline in health, with asthenia, fatigability, weight loss, headaches, generalized pain, and a subfebrile state. Two weeks before admission pulmonary symptoms appeared.

On entrance the patient had a productive cough; there was diffuse dullness over the right lung field and bullous and sibilant râles were heard. Radiologically, there was an infiltration involving almost all of the right lung, exempting only a small zone of the extreme base, suggesting by its cotton-like aspect a tuberculous infection. Sputum studies being negative for tubercle bacilli, a ten-day trial of sulfonamide therapy was instituted. No appreciable change occurred. Closer study revealed that twenty years before, while in military service, the patient had a chancre which was inadequately treated. Fifteen years later, on recall to military service, he had again submitted to a short course of antisyphilitic therapy for general symptoms identical to those of the present episode.

A small scar of the chancre could be seen. Also, there were scars of previous suppurative inguinal adenitis and of two gummas on the left thigh, On the chest and trunk there were pigmented areas such as are seen after secondary syphilitic skin lesions. The spleen was greatly enlarged, but it was not certain that this was due to syphilis. Serologic reactions were strongly positive. A trial of arsenical therapy was instituted, and in less than a month the pulmonary and general symptoms improved. Intensive arsenic and bismuth therapy was then pursued. Ten months later the lungs had cleared, leaving only a moderate amount of interstitial fibrosis. The spleen decreased in size but not to normal; it was thought that the enlargement was due to a combination of syphilis and malaria.

Three roentgenograms. CHAS. NICE, M.D.
University of Minnesota

Abnormal Radiologic Pulmonary Image in the Course of Secondary Syphilis. A. Duroux and Duchene. J. franç. de méd. et chir. thorac. **3:** 171–173, 1949. (In French)

A 38-year old man had moderate fever, general debilitation, and headache. History revealed that a brother had pulmonary tuberculosis and that the patient had sustained a serofibrinous pleurisy on the left eighteen years earlier. On admission, secondary syphilides were seen on the upper extremities and on the trunk. Small nodes were palpable generally, and especially in the inguinal and epitrochlear areas. A chest roentgenogram revealed small soft nodular densities in both lung bases. Arsenical and bismuth therapy caused a rapid disappearance of the cutaneous and pulmonary lesions.

Response to a therapeutic test may not be a reliable criterion for diagnosis, but since tuberculosis, sarcoidosis, Loeffler's eosinophilic infiltration, and parasitic infestation were ruled out by clinical studies, the authors believe this to be a case of pulmonary involvement by secondary lesions of syphilis. CHAS. NICE, M.D.
University of Minnesota

Thoracic Complications of Amebiasis. Robert R. Shaw. Surg. Gynec. & Obst. **88:** 753–762, June 1949.

The author presents a very concise report on the pleuropulmonary complications of amebiasis. The importance of amebic infestation is indicated by its prevalence, which has been variously estimated at 5 to 33 per cent of the population, a good average being 20 per cent. About 5 per cent of the cases will be complicated by hepatic abscesses, and of this latter group, 15 per cent will have complications within the thoracic cage.

Most amebic abscesses of the liver are single and 85 to 96 per cent are in the right lobe. Direct extension occurs through the diaphragm into the pleural cavity or into the lung. Instead of pleuropulmonary complications, left hepatic abscesses cause pericarditis. A less common cause of pulmonary complications is the passage of emboli from the hemorrhoidal veins through the portal circulation to the inferior vena cava and eventually to the lungs.

The roentgen picture of thoracic involvement is almost diagnostic, showing a hump in the diaphragm and, in the case of direct extension, a shadow extending in the pulmonary tissue to the hilus. Pulmonary abscess may be indicated by an annular shadow with a fluid level. There may be complicating empyema. A widened pericardial shadow is indicative of a possible rupture of an hepatic abscess into the pericardial sac.

Medical treatment with emetine and aspiration of the abscess is the method of preference, but thoracotomy is indicated in the presence of (1) secondary infection, (2) empyema not cured by repeated aspirations, (3) a persistent abnormal channel between the biliary ductile system and the bronchi, (4) fibrosis of pulmonary tissue producing a continued morbid state.

The author includes 4 case histories, and 12 roentgenograms are reproduced.

ROBERT J. AYELLA, M.D.
University of Pennsylvania

Bronchial Cancer of the Lingula. J.-M. Lemoine and F. Finet. J. franç. de méd. et chir. thorac. **3:** 166–168, 1949. (In French)

Carcinoma of the lingular portion of the left upper lobe is difficult to diagnose and is always masked by pulmonary suppuration. Three cases are presented. Bronchoscopic biopsy is often non-revealing. The difficulty is enhanced by the fact that non-malignant suppurative disease, with or without excavation, may be localized to this segment. Repeated bronchoscopy and cell-study of the sputum are recommended. (Tomography is also useful.)

Five roentgenograms. CHAS. NICE, M.D.
University of Minnesota

Arteriovenous Fistula of the Lung. F. D. Beddard. Brit. M. J. **1:** 1038, June 11, 1949.

A case of arteriovenous fistula of the lung is reported, in which the diagnosis was based chiefly on the roentgen findings. The postero-anterior film showed a mottled opacity in the lower zone of the right lung which on the lateral film overlay the lower part of the heart shadow. Between the opacity and the vascular markings of the right hilus was a longitudinal shadow which on tomography could be clearly identified as consisting of two

main parts representing branches of the pulmonary artery and vein. On fluoroscopy, opinion was divided as to whether the shadow pulsated, but it was noted in a bronchogram that, whereas nearly all the bronchial shadows, including those in juxtaposition to the heart, were present and clearly defined, those close to the main opacity were blurred. Angiography left no doubt regarding the vascular nature of the lesion.

Four roentgenograms.

Mediastinal Tumors. A. R. Curreri and J. W. Gale. Arch. Surg. **58:** 797–817, June 1949.

The wider use of thoracic surgery has led to the exploration of many more mediastinal tumors. Excluding malignant lymphomas, a diagnosis of such growths was made only 13 times from 1927 to 1940 at the Wisconsin General Hospital, while in the period since 1940 37 have been operated upon. The resulting improvement in correlation between the roentgenologic, clinical, surgical, and pathologic findings made it possible, in the authors' opinion, to diagnose 80 per cent of these tumors preoperatively.

The usual symptoms of mediastinal tumor are secondary to pressure or other complications. Dyspnea, cough, and pain are the most common. Rarely perforation of a cyst may lead to expectoration, and may be followed by secondary infection. Benign tumors may attain great size without producing symptoms. Vocal cord paralysis, generally produced by malignant growths, may occasionally result from a benign tumor.

The position of the tumor in the mediastinum permits a fairly accurate estimate of the type. Of anterior mediastinal tumors, 75 per cent are of dermoid derivation; 50 per cent of mid-mediastinal tumors are bronchogenic cysts, and 92 per cent of posterior mediastinal tumors are of neurofibromatous origin. Of superior mediastinal tumors, generally anterior, 65 per cent are either thyroid adenoma or thymoma.

In the study of these growths, free rein should be given the roentgenologist in securing the films and fluoroscopic studies he considers necessary, as well as in the use of diagnostic pneumothorax, bronchography, angiography, etc. The preoperative exclusion of malignant lymphoma and carcinoma is often difficult or impossible. Lymphomas are often bilateral and may be accompanied by grave clinical signs. Carcinoma frequently produces atelectasis and tends to have a hazy peripheral border.

Therapy is principally surgical. In bilateral tumors irradiation may be used as the primary procedure, since these are commonly lymphomas. Specific irradiation may follow surgery when indicated by the pathologic findings.

Case reports with illustrative roentgenograms and photographs of specimens serve to demonstrate more graphically the points emphasized.

Forty-two roentgenograms; 6 photomicrographs; 11 photographs.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

A New Method of Radiologic Exploration of the Heart and Lungs, and Its Use in Mediastinal Tumors. Maurice Marchal. J. de radiol. et d'électrol. **30:** 305–308, 1949. (In French)

The author briefly describes an apparatus of his own construction in which a photoelectric cell is connected to a fluoroscopic screen. The cell is in turn connected to electronic amplifiers and again to an oscilloscope which registers a tracing of pulsations on a photographic film. An electrocardiographic tracing is obtained simultaneously. The photoelectric cell is positioned wherever desired over the chest under fluoroscopic observation.

The tracings obtained have proved very interesting, even showing pulsations of the pulmonary arterioles—heretofore invisible on fluoroscopy or kymography—which were of value in the study of a few cases of lung pathology.

The use of the apparatus is described in two cases presenting mediastinal tumors which pulsated under fluoroscopic observation. One tumor, situated alongside the right cardiac border, gave auricular and ventricular types of pulsation depending on where the photoelectric cell was positioned over the tumor; the method without additional help permitted a diagnosis of mediastinal cyst. The other tumor gave a purely arterial type of pulsation no matter how the patient or the photoelectric cell was positioned and was diagnosed as an aortic aneurysm.

The correlation of the oscillographic and the electrocardiographic waves as related to time also helps in distinguishing the type and site of origin of the pulsations encountered and can usually distinguish accurately the true from the transmitted pulsations.

Four tracings; 2 roentgenograms.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Pneumomediastinum in the Newborn Infant. Felix Heald and T. S. Wilder. J. Pediat. **34:** 325–330, March 1949.

Pneumomediastinum should always be considered when cyanosis occurs in the neonatal period. There have been a few reports of this syndrome in the literature, and these the authors briefly review.

A case of pneumomediastinum in a one-day-old infant is reported. The child was brought into the hospital extremely cyanotic, comatose, and scarcely breathing. Respirations were rapid and shallow. Heart sounds were barely audible. The birth history was normal except that respiration was slower than usual in becoming established. Emergency treatment was given, and approximately twelve hours after admission the general condition was improved. However, a marked precordial bulge developed, with physical signs of emphysema over the entire thoracic cage. A roentgenogram of the chest showed widening of the mediastinal shadow bilaterally, with collapse of the right upper lobe. The heart was displaced as the result of air in the anterior mediastinal space. The patient became progressively worse and aspiration of the air was undertaken. Improvement followed, with eventual recovery.

The authors state that Macklin's studies show that pneumomediastinum begins with a generalized or local pulmonary emphysema. The alveoli become overdistended with air, some of which leaks out into the vascular sheaths, follows these up to the hilus, and hence enters the mediastinum. The air pressure in the mediastinum increases and may cause death, or decompression may occur as the result of extension of the air by one of three routes: (1) into the retroperitoneal space; (2) into the axilla, wall of the chest, or root of the neck and face; (3) between the parietal pleura

and pericardium, where it collects as air bubbles anterior to the heart.

In the case reported decompression occurred by the third route. This causes compression of the great veins, and circulatory embarrassment occurs.

Six roentgenograms; 1 table.

EUGENE R. KUTZ, M.D.
Baltimore City Hospitals

Intrathoracic Gastroenteric Cysts. Hugh Linder. Surgery **25:** 862–868, June 1949.

A case of intrathoracic gastroenteric cyst is presented, bringing the total in the literature to 28.

Being congenital, most of the cysts manifest themselves in infancy. They may be present in either side of the chest but are said to be more common on the right side. There is no sex predilection. The cysts vary greatly in size; they may be unilocular or multilocular and may extend through the diaphragm. They may be entirely unattached to the adjacent portion of the alimentary canal or there may be extensive attachment and communication. Communications with the bronchus are reported. The cysts may contain esophageal, gastric, or intestinal remnants in various combinations, but the gastric type predominates. Peptic activity and ulceration occur.

Clinical symptoms characteristically appear in the first few weeks or months of life and consist of dyspnea, cyanosis, cough, and usually evidences of pulmonary infection. Hemoptysis is common and hematemesis may occur. Most patients have been thought to have recurring attacks of pneumonia followed by empyema, the diagnosis becoming evident only after aspiration of fluid. This reaccumulates rapidly in the active cases, and peptic activity and acidity can be easily demonstrated.

X-ray examination reveals changes characteristic of posterior mediastinal tumor unless the hemithorax is so filled as to obscure the origin. In such instances the picture simulates loculated pleural effusion. If the fluid is removed and lipiodol injected, the cyst can be well shown. Mediastinal displacement and esophageal angulation may be demonstrated. The ribs and vertebrae may be eroded. Bronchograms may reveal a connection between bronchus and cyst, or there may be a demonstrable connection between the esophagus and cyst.

Treatment of this lesion is by surgical extirpation.

Three roentgenograms; 2 photomicrographs.

F. R. MCCREA, M.D.
Indiana University

Intrathoracic Meningocele. Francis X. Byron, Emery E. Alling, and Paul C. Samson. J. Thoracic Surg. **18:** 294–301, June 1949.

The authors present three cases of intrathoracic meningocele, one of which was operated upon successfully. They emphasize that radiographically it is difficult to differentiate between thoracic meningocele and neurofibroma. Furthermore, *café-au-lait* spots are not a distinguishing feature of neurofibromatosis, since they were present in one of the authors' cases of meningocele. The chief diagnostic aid in distinguishing this lesion from neurofibroma is the intraspinal injection of opaque medium, with demonstration of communication between the spinal canal and the lesion.

Surgical repair of intrathoracic meningocele is difficult. The authors feel that it should be attempted only with lesions which are so large that they produce dyspnea, pain, or other symptoms.

Ten roentgenograms; 1 drawing.

HAROLD O. PETERSON, M.D.
University of Minnesota

Fibrosis of the Pancreas in Infants and Children. An Illustrated Review of Certain Clinical Features with Special Emphasis on the Pulmonary and Cardiac Aspects. Charles D. May and Charles Upton Lowe. J. Pediat. **34:** 663–687, June 1949.

Fibrosis of the pancreas is a hereditary disease appearing at birth or soon thereafter and involving the lungs and the pancreas. The disease should be renamed with the pulmonary lesion, upon which the prognosis depends, being given prominence.

The pancreas develops an extensive, irreversible fibrosis with resulting pancreatic insufficiency. Meconium ileus, which should excite suspicion of this disease, was seen in 29 of the authors' 134 cases and speaks for the early development of the pancreatic lesion. In the fully developed cases, with absence of pancreatic enzymes, two factors were responsible for a wide variation in the clinical picture: adaptation of body functions so that fat and proteins were absorbed up to 60 per cent of the normal levels, and a good appetite which insured an adequate food intake. Thus in many instances good nutrition was maintained despite the existence of a severe digestive dysfunction.

The treatment of the pancreatic disease consists of a liberal diet plus treble doses of vitamins A and D. Substitution therapy with pancreatin is of little value.

The basic pulmonary lesion is bronchiolar obstruction by a viscid exudate, causing emphysema and atelectasis. Superimposed infection, which is invariable, produces peribronchial infiltration, bronchiolectasis, multiple small abscesses, and patchy pneumonitis. Clinically there may be cough, expectoration, dyspnea, cyanosis, clubbed fingers, and fever. The symptoms may show remissions when the lung infection improves or when bronchiolar spasm is relieved. However, bronchiolar obstruction, *per se*, is enough to cause death from anoxia, and in 6 cases of this series it caused atelectasis and emphysema severe enough to produce cor pulmonale.

Since the respiratory symptoms may be at variance with the roentgen findings, correlation is needed for a correct evaluation of the disease. As bronchiolar spasm and infection are improved or aggravated, the roentgenograms will show related changes, being in this respect a reflection of the extent of the pathologic changes. Emphysema is probably the chief finding and is generalized. Since the pathology is diffuse, the patches of atelectasis and pneumonitis, as well as the peribronchial infiltrate, tend to be diffuse. There is no evidence that the severity of the pulmonary process is dependent on the severity of the pancreatic lesion.

At present, nothing can be done to correct the abnormal secretion, so that treatment consists in control of the lung infection by means of aerosol antibiotics. Those patients who can be helped to live through the peak of the disease, which is from six to eighteen months after birth, are shown to have minimal respiratory symptoms at five to eight years of age.

Thirty-three roentgenograms; 16 photographs; 3 electrocardiograms.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

The Possibilities and Limitations of Roentgen Diagnosis. Pancoast Lecture. Leo G. Rigler. Am. J. Roentgenol. **61:** 743–761, June 1949.

There are three points of reference in determining the value of the roentgen method in the detection of an abnormal state at its onset: (1) the actual onset of the disease if this is known, (2) the time of onset of symptoms, (3) the size of a lesion necessary to be demonstrable by roentgen study. With these points in mind, the author has outlined the possibilities and limitations of the roentgen method in certain diseases of the thorax.

Pulmonary edema of the intra-alveolar type may be detected before the onset of symptoms, immediately after its onset, as shown by films obtained during pulmonary operations at a time when edema was known first to have occurred. Interstitial edema is poorly demonstrated.

Experiments on monkeys, recalculated in terms of human thoracic measurements, indicate that *pleural effusion* in amounts of 100 c.c. can be detected if roentgenograms are taken in the lateral decubitus position.

Bacterial pneumonias, in some cases, are demonstrable within a few hours after the onset of symptoms and in almost all cases within twelve hours.

Virus pneumonias do not give distinctive changes before twenty-four to forty-eight hours after the appearance of symptoms. The physical findings take even longer to develop.

In known *tuberculosis* contacts, it took three to five weeks for the tuberculin test to become positive and ten to twenty weeks for roentgen findings to become demonstrable. Those with known symptoms of tuberculosis usually have sufficient exudation so that the roentgen examination is positive. The exceptions are bronchial tuberculosis before the occurrence of bronchostenosis or parenchymal extension.

Symptoms in *miliary tuberculosis* may be present from one to seven weeks before roentgen evidence is obtainable. Even though the individual tubercles are 1 mm. or less in diameter, superimposition makes them visible on the roentgenogram if a sufficient number are present.

Nodular lesions, such as metastases, are demonstrable when they have attained a diameter of 3 mm. or more.

Patients seen by the author with roentgen evidence of *bronchogenic carcinoma* frequently had had previous films taken at other institutions. A study of these led to the conclusions that: (1) roentgen findings may be present when the patient is apparently well; (2) roentgen findings are almost always present if the patient has symptoms; (3) if physical signs and symptoms are present, an adequate roentgen examination, particularly in different phases of respiration, will almost invariably produce evidence of abnormality.

Eighteen roentgenograms. RALPH T. LEVIN, M.D.
Indiana University

Fate of Cardiac Foreign Bodies. James M. Fritz, Melvin M. Newman, Robert W. Jampolis, and W. E. Adams. Surgery **25:** 869–879, June 1949.

The authors report the result of an experimental investigation into the fate of cardiac foreign bodies, a subject in which there has been increased interest as a result of World War II. Numerous theoretical justifications have been offered for the surgical removal of foreign bodies from the heart. Among these are (1) prevention of embolism of the foreign body or an associated thrombus; (2) reduction of the danger of bacterial endocarditis; (3) prevention of recurrent pericardial effusion; (4) diminution of the incidence of myocardial damage; (5) the danger of (*a*) cardiac rupture, especially rupture of a cardiac aneurysm, (*b*) of migration into an adjacent cavity with embolism formation or interference with capacity or function in the chamber, and (*c*) of injury to a coronary vessel. In addition, there is a profound psychologic effect upon the patient whose knowledge of a retained foreign body is combined with minimal symptoms. Without the precedent of established routine, the surgeon may be unable to furnish any authoritative information as to the prognosis.

Sixty-two dogs were studied following the surgical introduction of foreign bodies simulating shell fragments. The fragments of metal were introduced into the pericardial sac, the right and left myocardium, and also directly into the right and left auricular and ventricular cavities. Only 3 dogs died as the result of the foreign body—2 from embolism and occlusion of a systemic artery and the other from infection.

The authors found that pericardial foreign bodies produced minimal local reaction and were well encapsulated within eight weeks. No pericardial effusion or generalized fibrous reaction was produced such as might be a precursor of a constrictive pericarditis.

Of 35 foreign bodies introduced directly into the chambers of the heart, only 3 remained within the heart and these produced no untoward findings. The remaining 33 were quickly embolized to pulmonic or systemic circulation.

Of 18 foreign bodies placed in the myocardium, only 2 caused serious results; one because of infection and one because of an associated extensive infarction of the myocardium due to injury to the coronary artery at the time of surgery. The other 16 caused only minimal local reaction and were firmly encapsulated in a fibrous scar by the end of eight weeks. The removal of these foreign bodies from the myocardium was accomplished only with additional myocardial damage. There was no case of migration of the foreign body from the myocardium into the chambers of the heart.

The authors conclude that it is not necessary to remove foreign bodies in and about the heart so long as they are not producing symptoms or signs of cardiac dysfunction.

Twelve illustrations, including 5 roentgenograms; 5 tables. P. B. LOCKHART, M.D.
Indiana University

Pericardial Effusion: A Constant, Early and Major Factor in the Cardiac Syndrome of Hypothyroidism (Myxedema Heart). Richard A. Kern, Louis A. Soloff, William J. Snape, and Carmen T. Bello. Am. J. M. Sc. **217:** 609–618, June 1949.

Since Zondek's first report in 1918, it has been recognized that a certain number of patients with myxedema display cardiac phenomena that have been designated "myxedema heart." These phenomena have usually been attributed by clinicians to a uniform dilatation, cryptic in nature, of all cardiac chambers. An occasional roentgenologist has commented on the similarity of the roentgenologic phenomena in these cases to those of pericardial effusion, but there are relatively few recorded instances of proved pericardial effusion in patients with myxedema. A review of the literature revealed only 21 cases. The prevailing clinical view,

therefore, is that pericardial effusion is only rarely a contributory factor to the enlargement of the cardiac silhouette in this disease. The authors believe that this requires revision. They present 4 consecutive cases of myxedema in which they have demonstrated considerable pericardial effusion, even when roentgenologic findings were not suggestive of its presence, and in the absence of congestive failure. In all 4 cases the effusion cleared under thyroid medication, and in one instance this phenomenon was observed in 2 additional periods of hypothyroidism induced with the patient's consent by omitting treatment.

The electrocardiographic changes of "myxedema heart," hitherto ascribed to myocardial changes and to the effects of tissue edema, can even better be explained by the effect of a blanketing pericardial effusion. This view is strongly suggested and supported by electrocardiographic improvement between two tracings taken on the same day just before and just after the aspiration of the pericardial fluid.

In view of these operations, the authors conclude that pericardial effusion is a constant, an early, and a major factor in the cardiac findings in myxedema.

The fallibility of the roentgenological method in the diagnosis of pericardial effusions, even when they are of considerable size, is emphasized. The obliteration of the acute re-entering cardio-hepatic angle proved of no value in the cases reported. The most significant diagnostic signs of pericardial effusion were the feeble sluggish movement of the shadow on fluoroscopy, the diminished heart sounds, and the obliterated or feeble apex impulse with a wide precordial dullness on physical examination, and possibly the added help from the electrocardiogram. "Perhaps the roentgenologist should acknowledge his limitations by speaking of the 'pericardial' rather than the 'cardiac' silhouette."

Ten roentgenograms; 2 electrocardiograms.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Tetralogy of Fallot: Surgical Treatment. A. Rodriguez Diaz and H. Anido. Dis. of Chest **15:** 684–689, June 1949.

The authors tabulate their experiences with 17 cases of tetralogy of Fallot. The Blalock operation was performed in 12 and the Potts' operation in one. In one case, in which two superior venae cavae were present, the operative intervention consisted of ligation and section of the persistent superior vena cava. In one case, no pulmonary artery was found. In two cases, the operation could not be completed because auricular fibrillation developed accompanied by a marked fall in blood pressure, after the pleural cavities were opened. Fifteen patients survived surgery.

An accurate diagnosis of tetralogy of Fallot may be accomplished only by angiocardiography or cardiac catheterization; the authors use angiocardiography routinely because of its comparative simplicity and the anatomical information which it furnishes.

During a postmortem examination on a 10-year-old child who had had a tetralogy, the authors found an anomalous vessel connecting the left subclavian and the left pulmonary artery. This attempt of Nature to increase the blood supply to the lungs is identical with the procedure advocated by Taussig.

Three roentgenograms; 1 table.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Fluorocardiography (Electrokymography). Aldo A. Luisada and Felix G. Fleischner. Am. J. Med. **6:** 756–771, June 1949.

Observations on normal subjects and the first clinical applications of a new method of study of volume changes and motions of the cardiac chambers and the large vessels are reported, together with a description of the technic. This method, which in general is called fluorocardiography, permits inscription on a continuous film of either the motions of the border of the cardiovascular silhouette, as seen on the fluoroscopic screen, or the changes in the density of the cardiovascular shadows. The two types of tracings are termed border tracings and densograms, respectively.

Various tracings and their physiologic interpretations are given in detail.

Among the studies of cardiovascular physiology reported are one on the temporal relationship between the contractions of the right and left heart; one on the velocity of the right and left heart; one on the velocity of the arterial pulse wave in the pulmonary circulation; one on the isometric relaxation period of the left ventricle; and one on pressure recording in the pulmonary artery.

The results of two systematic clinical studies are presented, one in mitral valve lesions, the other in myocardial infarction. Clinical findings in cases of uncomplicated shunts, cor pulmonale, pericarditis, heart block, and aortic aneurysm are also included.

Eleven illustrations.

Radiocardiography and Its Clinical Applications. Myron Prinzmetal, Eliot Corday, Ramon J. Spritzler, and Walter Flieg. J. A. M. A. **139:** 617–622, March 5, 1949.

Radiocardiography is a method of recording graphically the passage of radioactive blood through the cardiac chambers by means of a specially constructed ink-writing Geiger-Müller counter. The method has been found helpful in the diagnosis and prognosis of a number of cardiac conditions.

The details of performing the examination are discussed at length. Briefly, 0.1–0.2 millicurie of radiosodium (Na^{24}) is injected in the antecubital vein and the concentration of the radioactive material in the heart and surrounding structures is recorded by the shielded Geiger-Müller counter overlying the precordium. A diphasic tracing is obtained in normal individuals, divided into R and L waves as the counter records concentration in the chambers of the right and left sides of the heart, respectively. The characteristics of the waves in normal and abnormal tracings are described.

While the method is still experimental, the authors find it a simple and safe procedure for determining the pumping qualities of the heart.

Fourteen radiocardiograms; 1 photograph.

D. J. SAYLES, M.D.
University of Michigan

Angiocardiographic Study of the Pulmonary Artery. Charles T. Dotter and Israel Steinberg. J. A. M. A. **139:** 566–571, Feb. 26, 1949.

The authors present an angiocardiographic study of the pulmonary artery both under normal conditions and in the presence of disease, congenital and acquired.

Many of the commonly encountered congenital car-

diovascular anomalies are manifested in part by morphologic or dynamic changes in the pulmonary artery, the most frequently observed change being dilatation. Rarely this is idiopathic. More often it is associated with patent ductus arteriosus, septal defects, or pulmonic stenosis, in which there may be widening beyond the point of narrowing. In other congenital defects the artery may be small or absent, as in the tetralogy of Fallot, tricuspid atresia, and pulmonic stenosis or atresia.

In no other cardiac abnormality is angiocardiography of such great value as in the tetralogy of Fallot, not only for establishing the diagnosis but as an aid to the surgeon in planning the operation, avoiding unproductive approaches, and saving valuable time.

In mitral stenosis, the earliest change observed angiocardiographically has been enlargement of the left atrium, followed infrequently by enlargement of the pulmonary artery and right ventricle. This is in accordance with conventional roentgenoscopic observations. With the aid of angiocardiography, aneurysmal dilatation of the pulmonary artery may be identified with ease. Dilatation of the artery and its major branches may be seen, also, in the presence of congestive heart failure, chronic pulmonary disease, and kyphoscoliosis. It is suggested that the diagnosis of pulmonary heart disease can be made far in advance of the appearance of cyanosis, not only with angiocardiographic methods but also with conventional roentgenoscopy, and it is believed that the official criteria for the diagnosis of this condition are in need of modification.

Seven roentgenograms.

Thoracic Aortography by Means of a Cannula Inserted Percutaneously into the Common Carotid Artery. Gunnar Jönsson. Acta radiol. **31:** 376–386, June 30, 1949.

Jönsson reports a new method for thoracic aortography, designed to give a better concentration of the opaque material in the aorta than can be obtained with the usual method of angiocardiography and to eliminate the hazards of direct catheterization through the radial artery.

He uses a double cannula 13 cm. long containing an inner sharp needle which projects sufficiently to be used for percutaneous puncture of the common carotid artery as high in the neck as possible. This inner needle is withdrawn as soon as the lumen of the artery is entered and is replaced by a blunt silver thread, which is inserted into the aorta. (The position of the latter has been previously marked on the skin during roentgenoscopic examination.) Injection of 40 to 80 c.c. of a 50 per cent solution of diodrast is then accomplished by a specially constructed pressure device through a hard rubber connecting tube, and serial roentgenograms are made in two planes.

Jönsson recommends this method for lesions of the arch and descending portion of the aorta, especially coarctation. It should not be used when disease of the carotid or innominate artery is suspected. For diagnosis of patent ductus arteriosus the author recommends the method of catheterization through the radial artery, because a possible shunt near the sinus of Valsalva is better seen by this method.

A 70 per cent solution of the dye should not be used because of the possibility of convulsions. All patients were given penicillin and heparin prophylactically.

The method seems to be one which can yield positive results but is attended by the usual risks associated with direct instrumentation of the aorta.

Four roentgenograms; 3 photographs.

HARRISON SHAPIRO, M.D.
Mt. Sinai Hospital of Cleveland

DIAPHRAGMATIC HERNIA

Right-Sided Diaphragmatic Hernia. G. A. P. Hurley. Canad. M. A. J. **60:** 614–615, June 1949.

Right-sided diaphragmatic hernia is the rarest form of non-traumatic diaphragmatic hernia. In a series of 430 cases of diaphragmatic hernia recently reported, this type comprised only 1.8 per cent. Herniation usually occurs through the foramen of Morgagni between the right costal and sternal origins of the diaphragm. Colon and omentum are most commonly involved.

Symptoms are pain, from obstruction to the gut, and cough and dyspnea as a result of atelectasis of the right lower lung due to pressure from the misplaced viscera. Radiologically, an abnormal area of opacity is seen anteriorly in the right cardiophrenic angle. Barium examination of the gastro-intestinal tract establishes the diagnosis if gut is present in the hernia, but is not of much help if the sac contains only omentum. If x-ray studies are inconclusive, bronchoscopy should be done to rule out obstruction of the middle lobe bronchus by neoplasm.

Treatment is surgical. Exploratory thoracotomy through the 4th and 5th interspaces is indicated if the diagnosis is in doubt and an intrathoracic non-tuberculous lesion is suspected. The abdominal approach is easier and safer when the diagnosis has been established preoperatively.

The author presents the case of a 17-year-old male who was operated on and recovered uneventfully, with no x-ray signs of recurrence of the hernia three months postoperatively.

Four roentgenograms.

HARVEY J. THOMPSON JR., M.D.
Jefferson Medical College

THE DIGESTIVE SYSTEM

Roentgen Manifestations of Infantile Hypertrophic Pyloric Stenosis. Herbert M. Olnick and H. Stephen Weens. J. Pediat **34:** 720–729, June 1949.

Nineteen of 21 surgically proved cases of congenital hypertrophic pyloric stenosis showed specific roentgen evidence of the defect, consisting of the string sign, seen in all 19 cases, and indentation of the base of the duodenal bulb, seen in 7 cases. The hypertrophy of the pyloric muscle which enlarges to include the prepyloric segment produces a narrow, elongated canal at the junction of stomach and duodenum which is represented radiographically as a linear barium streak—the string sign. In severe cases, only the proximal part of this stenotic canal is filled with barium, producing a beak-like projection from the distal part of the pyloric antrum. The indentation of the base of the duodenal cap is caused by the protrusion into it of the hypertrophic muscle mass. The associated signs of gastric dilatation, delayed emptying, and gastric hyperperistalsis are regarded as non-specific.

The authors administered 1 to 2 ounces of a thin barium mixture through a stomach tube following as-

piration of any gastric contents. Fluoroscopy in the lateral and oblique positions with spot-filming was used to demonstrate the defect, after which the residual barium was aspirated.

Follow-up studies done on 16 cases at intervals of five months to twenty-two years after successful surgery showed residual pyloric deformity in 15, consisting of varying degrees of narrowing and diminution or absence of peristalsis, although these changes were less pronounced than those seen during the manifest stage of the disease. In spite of these changes, gastric emptying was normal.

Eleven illustrations.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Roentgenologic Diagnosis of Prolapsed Gastric Mucosa. Chapin Hawley, Paul D. Meyer, and Benjamin Felson. Am. J. Roentgenol. **61:** 784–796, June 1949.

The incidence of gastric prolapse in a series of 1,257 upper gastro-intestinal studies done in a twelve-month period at the Cincinnati General Hospital was 2.8 per cent, about the same as that of gastric ulcers or neoplasms.

Nine cases are presented in which there was no unusual finding clinically or roentgenographically, except the prolapse. Recurrent epigastric pain often relieved by food, milk, or alkalis, seemed to be the most constant symptom. Nausea, vomiting, gas, and belching were other frequent complaints. Hematemesis was never definitely demonstrated in any of this group. Bland diet, antacids, and antispasmodics produced improvement without exception. Though a number of cases in the literature have presented clinical histories similar to those recorded here, the authors believe the evidence is still too inconclusive to permit acceptance of gastric prolapse as a definite clinical entity.

The roentgen findings are: mushroom appearance of duodenal bulb with concavity of the base where the gastric nucosa is invaginated; mucosal folds passing from the stomach to the duodenum; circular or longitudinal accumulations of redundant mucosa in the antrum when the prolapse is temporarily reduced; normal peristalsis through the area; rugal folds of normal size; no narrowing or elongation of pyloric channel; no ulcer niche; no irritability of the duodenal bulb. The prolapse varies in degree, reducing itself at intervals.

Twenty-nine roentgenograms; 2 photographs in color; 1 table.

R. C. DATZMAN, M.D.
Indiana University

Gastroscopic Perforation of the Esophagus and Stomach. Report of Three Cases. Leonard M. Asher and Sidney Cohen. Gastroenterology **12:** 966–969, June 1949.

Three cases of gastroscopic perforation of the esophagus and stomach are reported. All 3 patients had malignant lesions at the site of puncture. In 1 the perforation occurred in the upper esophagus, at the level of a thyroid adenocarcinoma, in the other 2 through a carcinoma on the posterior gastric wall. In no instance was there clinical or x-ray evidence of obstruction. These experiences have caused the authors to proceed with great caution in any patient where a cancer might be encountered along the path of the gastroscope, and they are restricting the examination of cancer of the inlet of the stomach to those cases in which x-ray studies are inconclusive.

All three patients recovered from the effects of the perforation. The management may be conservative.

EDWARD E. LEVINE, M.D.
Dearborn, Mich.

Clinical Importance of Duodenal Diverticula. Edgar M. Dunstan, Mason I. Lowance, and Eugenia C. Jones. South. M. J. **42:** 460–466, June 1949.

There is considerable variation of opinion regarding the significance of duodenal diverticula and consequently regarding their proper treatment. It is important to recognize that these lesions are not altogether harmless, as is the usual conception.

The authors discuss the diagnosis and treatment based on their series of 32 cases. They report one case in which a leiomyosarcoma occurred in a duodenal diverticulum, bringing the number of such cases in the literature to four. They report a leiomyoma in another case. Six patients in the series (19 per cent) were under forty years of age. The diverticulum, or its complications, was proved to be responsible for symptoms in 4 cases and was felt to be non-productive of symptoms in 14 cases. Considering the total number of gastrointestinal series done over a seven-year period, there was a 2.2 per cent incidence of duodenal diverticula.

While many writers feel that abnormal barium retention is an indication of pathologic function of a diverticulum, the authors did not find this sign altogether reliable. Eight of 14 untreated cases showed abnormal retention, and 7 of 18 cases which required treatment. In one case demonstration of a large mass and non-visualization of the gallbladder led to a preoperative diagnosis of gallbladder disease with possible malignant growth; the diverticulum was never shown in barium studies. In another instance the diverticulum was seen on all films but failed to fill with barium and was not believed to be a part of the intestinal tract.

The fact that some of the most serious complications in the series were present in undiagnosed diverticula, or were unrecognized preoperatively when a diagnosis of diverticulum was made, suggests that this lesion should be regarded with increased respect.

Six roentgenograms; 2 photomicrographs; 3 photographs; 3 tables.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Right Paraduodenal Hernia, with Report of a Case. James R. Thomason and William H. Moretz. Surgery **25:** 935–940, June 1949.

Paraduodenal hernia is uncommon. It occurs chiefly on the left. The type occurring on the right has its origin in the mesentericoparietal fossa of Waldeyer, which is usually in the first part of the mesojejunum behind the superior mesenteric artery and immediately below the duodenum, with its orifice looking to the left and its blind extremity directed to the right and downward. The authors found in the literature 50 cases of right paraduodenal hernia, with 31 operations and 18 recoveries. They add a case with recovery, which they believe is the first to be reported following a subtotal gastric resection. Cogswell and Thomas (Ann. Surg. **114:** 1035, 1941) are quoted as stating that a preoperative diagnosis has been made only twice. In the present instance the diagnosis was unsuspected prior to laparotomy.

The chief diagnostic signs are repeated attacks of abdominal colic, abdominal tenderness with distention relieved by the passing of flatus, and visible peristalsis, with a tympanic, elastic mass in the abdomen.

Roentgen diagnostic points as outlined by Case and Upson (J. A. M. A. **87:** 891, 1926) and Exner (Am. J. Roentgenol. **29:** 585, 1933. Abst. in Radiology **22:** 642, 1934) include the following:

(1) Abnormal location of jejunum on right side of abdomen.
(2) Downward continuation of jejunum from the second portion of duodenum.
(3) Absence of third and fourth portions of duodenum traveling to the left across the spine.
(4) Dilatation of duodenum as a result of constriction or angulation of the proximal jejunum by the neck of the peritoneal sac.
(5) Clumped appearance of intestinal coils and inability to displace these coils by manipulation or change of position.
(6) Axis of this mass of loops to the right of the midline.
(7) Absence of small bowel loops in pelvis.
(8) Demonstration of delayed motility of barium through the herniated bowel and possible demonstration of points of constriction in neck of the sac.

One roentgenogram; 1 diagram.

M. M. MANALAN, M.D.
Indiana University

Some Observations upon the Radiology of the Small Intestine in Old Age. H. J. Jungmann and L. Cosin. Brit. J. Radiol. **22:** 325–330, June 1949.

Because apparent abnormalities of the small intestine, unexplained on clinical grounds, were frequently observed in old people during investigations for ulcer, a special study was made of 18 people over seventy years of age. These were all patients who had no gastro-intestinal history and in whom there was no clinical reason for suspecting any nutritional or other disorder which might affect the small bowel. Barium sulfate in distilled water by mouth was used.

Eleven of the subjects showed definite hypertonus, either in the mid-region (distal jejunum and proximal ileum) or in the terminal ileum. It was most common between the first and second hour following the barium meal, disappearing later. Three cases showed persisting hypotonus. Segmentation was observed in 15.

The authors suggest that in people of advanced age abnormalities of the small intestine do not necessarily indicate intrinsic disease, but may be related to cerebral arteriosclerosis. This view is based on Cannon's theory of the nervous control of the gastro-intestinal tract by pontine centers.

Eleven roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Streptomycin in the Treatment of Tuberculous Enteritis. A Report of Thirty-Three Cases. Edward F. Mason, William W. Kridelbaugh, William H. Crouch, and Melgie Ward. Am. J. M. Sc. **217:** 28–46, January 1949.

This is a summary of the experience gained in 15 Veterans Administration hospitals in the treatment of 33 patients ill with pulmonary tuberculosis complicated by tuberculous enteritis. Patients were treated both for cure of the intestinal disease and, in some cases of incurable pulmonary tuberculous, for symptomatic relief.

Most patients received streptomycin intramuscularly, in doses ranging from 1.0 to 2.0 gm. daily; the former now being favored because of the lower incidence of vertigo. Length of treatment course ranged from fourteen days, for symptomatic relief, to one hundred and twenty days.

The drug has been found to be uniformly effective in relief of the symptoms of enteritis—fever, abdominal pain, diarrhea, and weight loss. Maximum benefit was reached in most cases within one week. In only 8 of the 33 cases did the sputum become negative following relief of symptoms. There was little improvement in the pulmonary disease in the majority of cases.

Radiologic studies before and after treatment were available in 17 cases. In 6 of this group the findings returned to normal after treatment; in 8 definite improvement was seen, but residual deformity remained; 2 patients showed marked residual deformity, and 1 showed signs of obstruction. Where the roentgen signs are those of irritation (spasm, hypermotility, loss of haustrations, and mucosal irregularity), return to normal can be expected. Where ulceration has been deeper and of longer duration, with destruction of bowel wall architecture, the changes will be persistent and may even progress.

Eight cases are still under treatment. There have been only two recurrences in the remaining 25 cases, which have been followed one to sixteen months. One patient with terminal pulmonary disease has died.

Ten illustrations, including 8 roentgenograms.

JAMES C. KATTERJOHN, M.D.
Indianapolis, Ind.

Roentgen Examination of the Defunctioned Colon after Ileostomy, with Special Reference to the Safety and Practical Value of Thorium Dioxide as a Contrast Medium. Harrison J. Shull, Milford D. Schulz, and Chester M. Jones. Gastroenterology **12:** 1–9, January 1949.

There is the theoretical danger of barium sulfate becoming inspissated and forming undesirable foreign bodies when defunctioned loops of colon are studied with the routine barium mixture. This leads many clinicians to omit or postpone necessary interval examinations of the colon, particularly in patients with idiopathic ulcerative colitis in whom ileostomies have been performed. The authors report the results of 20 examinations with thorium dioxide solution and 54 examinations with barium sulfate, all in patients with defunctioned colons and ileostomies. Acute bowel symptoms developed in 2 of the 20 patients studied with thorium, and in 4 of the 54 studied with barium.

It is concluded that thorium dioxide offers a satisfactory additional means of examining the defunctioned large bowel, but that its routine use in preference to barium sulfate need not be encouraged. The incidence of undesirable effects from the use of both methods is about the same, and it is low. Periodic roentgenologic examination of the defunctioned colon in the patient with ulcerative colitis is indicated.

Seven roentgenograms.

JAMES C. KATTERJOHN, M.D.
Indianapolis, Ind.

Diagnosis of Cancer of the Large Bowel. Neil W. Swinton, Hugh F. Hare, and William A. Meissner. J. A. M. A. **140:** 463–468, June 4, 1949.

One hundred cases each of cancer of rectum, left colon, and right colon are reviewed. The chief complaints were rectal bleeding (80 per cent), alteration in bowel function, and abdominal pain. Other complaints may be significant, such as unexplained anemia or abdominal tumor.

Rectal bleeding most frequently originates in the anal canal, and may be due to hemorrhoids, fissures, polyps, and other lesions which rarely, if ever, undergo malignant change. Anal carcinoma is rare, but since it does occur, the patient should have careful inspection of the perianal area and orifice, digital and anoscopic examinations.

The majority of tumors will be found above the anal canal. Benign mucosal polyps occur more frequently than is generally appreciated: they were found in 7 to 10 per cent of patients dying from all causes. The incidence increases with age and there is a high percentage of multiplicity of these tumors, which are true pre-malignant lesions. Only one-third of patients with benign mucosal polyps complain of rectal bleeding; therefore, routine sigmoidoscopic as well as digital examination is advisable.

The differential diagnosis between benign and malignant polyps is at times extremely difficult. Induration and fixation are pathognomonic for malignancy. Usually, however, reliance must be placed on the pathologic findings. Pathologists are cautioned, however, against diagnosing some of the borderline lesions as malignant, thus leading to radical surgical procedure, usually with permanent colostomy.

Examination of the colon beyond the reach of the sigmoidoscope (10 inches) is accomplished by radiological means. Thirty per cent of cancers encountered in the colon and rectum occur in this region. The routine barium sulfate enema is the most valuable radiologic procedure. Double-contrast air studies have been overestimated, but are valuable for the diagnosis of polyps. Stereoscopic roentgenography and repeat studies are necessary for the most accurate results.

In the authors' series the most important problem was the differential diagnosis between malignant disease and diverticulitis of the sigmoid. This problem may be settled by the history and physical findings, sigmoidoscopic study, and particularly the radiologic findings. In some instances actual surgical exploration and examination of the tissue by the pathologist are required.

Five roentgenograms; 4 photomicrographs; 2 tables. GABRIEL WHITEMAN, M.D.
Louisville, Ky.

Diagnostic Difficulties in Rectosigmoid Lesions. Vernon B. Blaha and Harry C. Saltzstein. Am. J. Digest. Dis. **16:** 206–213, June 1949.

The differential diagnosis of rectosigmoid lesions is often difficult. Even after a careful history, digital examination, proctosigmoidoscopy, and roentgen study, the exact nature of the lesion may still be in doubt.

The early symptoms of rectal lesions have been repeatedly emphasized as (*a*) any abnormality of the stool, including pus or blood; (*b*) any change in normal bowel habit; (*c*) unexplained abdominal cramps; (*d*) unexplained abdominal tumor or anemia.

The intrinsic lesions include malignant neoplasms, benign tumors, polyps, infections, congenital and acquired strictures. Extrinsic tumors or inflammatory diseases in the pelvis may deform the rectum, either by pressure or infiltration.

At the level of the mid-sigmoid and above, the x-ray examination is very accurate; whereas in the rectosigmoid area the mucosal pattern is so indefinite that the findings are sometimes not conclusive. In the rectum, x-ray diagnosis is of very little value.

If the films are studied along with the information gained by the history and physical examination, a great deal can be learned about the deformity each lesion should produce. Tumors, for instance, such as fibroids and ovarian cysts, will indent the rectum, but the mucous membrane will be shown to be intact, and the shadow of the tumor may be shown on the roentgen films. If malignant lesions become attached, as retroperitoneal sarcomas are prone to do, there is a sharp edge between the involved and uninvolved bowel. Benign extrinsic lesions around the rectum do not ulcerate into the mucosa, but malignant ones do, so that differentiation between an intrinsic and extrinsic lesion cannot be made radiologically. The frozen pelvis and injury from irradiation treatment usually show a fixed non-tender constricted area of bowel.

Endometriosis can cause a slight irregularity of the bowel from 4 to 10 inches in length, or it can produce an obstruction which looks the same as one from any other cause. Postoperative adhesions may cause a complete or partial obstruction, but the area of obstruction is short and the mucous membrane pattern is intact.

Perforation of the rectosigmoid by foreign bodies will cause a stenotic constriction of the bowel, but the mucous membrane will usually be intact.

A perirectal abscess will cause a smooth deformity by pressure. A fistulous tract may sometimes be revealed by an irregularity of the mucosal pattern.

Case histories are presented of a retrorectal abscess that was originally diagnosed radiologically as a carcinoma; acquired megacolon that was confused clinically with a carcinoma of the rectosigmoid; a parasigmoid appendiceal abscess that gave a roentgen appearance of carcinoma; and a carcinoma that was confused over a period of years with diverticulitis.

Nine roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Intestinal Obstruction Caused by a Gallstone. Charles W. Mayo and Philip Walling Brown. Surgery **25:** 924–930, June 1949.

This paper represents a composite study of 18 cases of intestinal obstruction by gallstones seen at the Mayo Clinic, of which 10 have been previously reported (Wakefield, Vickers, and Walters: Surgery **5:** 670, 1939). In all but one of the 18 cases the stone had perforated into the duodenum, the exception being a direct perforation into the colon. The obstruction is usually due to a single large stone; there may be a history of multiple small stones which have been expelled. The point of arrest of the calculus depends usually upon an intestinal narrowing; in 10 of the reported series the stone had lodged in the lower three feet of the ileum. Rarely does the gallstone traverse the small bowel to become arrested in the colon.

Sixteen of the 18 patients were females, and the ages ranged from thirty-one to eighty-one. The past history was one of intermittent attacks ascribed to cholecystic

disease in some instances, and of a single attack of obstruction in others.

Six case histories are presented, each representing a step in the pathogenesis of this entity from the acute attack of colic with paralytic ileus to the actual establishment of the cholecystoduodenal fistula with obturator obstruction by delivery of the stone into the intestinal tract.

One drawing; 1 table. JOHN W. WILSON, M.D.
Indiana University

Congenital Absence of the Gall Bladder. Woodrow Nelson, Floyd F. Hatch, and Henry M. Jackson. Surgery **25:** 916–923, June 1949.

Congenital absence of the gallbladder as an isolated biliary tract anomaly is of infrequent occurrence (found in 0.065 per cent of 18,350 autopsies). It is more often associated with other anomalies of the biliary system.

Absence of the gallbladder apparently does not incapacitate the individual, and indeed it may, for unexplained reasons, give rise to typical symptoms of cholecystitis. If at surgical exploration the gallbladder cannot be found after careful inspection, a cholangiogram may be of aid in ruling out a misplaced organ. In view of a probable atonic sphincter of Oddi in congenitally acholecystic cases, it is suggested that the duct be compressed distal to the point of injection of diodrast. Absence of the gallbladder is frequently accompanied by a stone in the common duct.

Oral cholecystography, of course, will not reveal a gallbladder shadow, but this may be misinterpreted as indicating a non-functioning organ. A confirmed preoperative diagnosis of congenital absence has not yet been made. The case reported here was diagnosed as chronic cholecystitis with possible cholelithiasis.

Two drawings; 1 roentgenogram.
M. M. MANALAN, M.D.
Indiana University

Stratification of Bile in the Gall Bladder and Cholelithiasis. B. A. Campbell and A. C. Burton. Surg., Gynec. & Obst. **88:** 731–738, June 1949.

Most reviews in the literature on the composition of bile in the gallbladder, and on the concentration function of that organ, imply that its contents can be thought of as homogeneous, so that a sample of bile from any part would be representative of the whole.

Yet roentgenologic evidence indicates that a high degree of inhomogeneity of bile may exist in normal subjects as well as in cholecystitis. Roentgenograms show that the bile in the lowest part of the gallbladder often has a markedly greater radiopacity than that above, with one or more sharp lines of demarcation between. When "floating" gallstones are present, these are often found to lie in the region of the apparent separation between two layers.

The authors sought evidence, other than roentgenologic, for or against the presence of strata in the gallbladder. They suspended the gallbladders of cats and drew off samples from the neck down to the fundus at 1-cm. intervals. The results showed that the bile of many normal gallbladders was not of a homogeneous composition.

The same procedure was carried out on 65 gallbladders from cattle, and measurements of viscosity, specific gravity, and hydrogen ion concentration were made. There was a sharp increase in all three from top to bottom. The results showed that inhomogeneity of bile in the gallbladder in cattle was the rule rather than the exception. Furthermore, specimens collected in a tall cylinder and sampled in the same manner showed no significant mixing of the strata after one week. Several similar investigations were carried out on human gallbladders obtained at operation, with like results.

The authors explain strata formation as due to incomplete emptying of the gallbladder, with dilute hepatic bile layering on top of more concentrated bile. A second partial contraction and relaxation may introduce a third layer, and so on. They suggest the possibility that persistent stratification of bile may favor the precipitation of cholesterol stones.

Eleven illustrations, including 1 roentgenogram; 2 tables. RICHARD C. RIPPLE, M.D.
University of Pennsylvania

THE MUSCULOSKELETAL SYSTEM

A Method for the Quantitative Roentgenological Determination of the Amount of Calcium Salts in Bone Tissue. Its Use in the Study of Calcium Reduction in the Phalanges of the Fingers in Chronic Polyarthritis. Arne Engström and Sölve Welin. Acta radiol. **31:** 483–502, June 30, 1949.

The purpose of this paper is to present a method of roentgenographically determining the calcium content of bone per unit volume on an objective basis. Special interest was directed at the reduction of the calcium salts in the phalanges in chronic polyarthritis.

The method consists of obtaining radiographs of the thumb and index fingers at constant technical factors and with controlled developing conditions. Aluminum step wedges are placed on the film. Photometer measurements of the density in the step wedges were plotted as a function of the thickness of the steps. Similar measurements at constant points in the bones were made and compared with this curve after allowance was made for the thickness of the soft tissue and the absorption of the rays therein.

Normal control studies were made in both males and females, and the amount of absorption per unit of bone volume was determined. A group of 20 patients with polyarthritis of varying degree was studied and the absorption of the roentgen rays calculated in a similar manner and compared with the results obtained in normal controls. It was found that some of the milder cases yielded values in the normal range, but with the more severe cases (as clinically assessed) there was definite objective evidence of loss of calcium salts as demonstrated by the lower absorption of the rays in the bone.

The authors suggest that the rate of progress of the disease can be followed more accurately by such objective measurements and that the method can be applied to other diseases as well.

Fourteen statistical tables summarizing the actual measurements are presented. One roentgenogram; 3 drawings. HARRISON SHAPIRO, M.D.
Mt. Sinai Hospital of Cleveland

Arachnodactyly (Marfan's Syndrome). Two Case Reports with Etiological Implications. Robert C. Moehlig. Am. J. Roentgenol. **61:** 797–807, June 1949.

Two cases of arachnodactyly are presented. Clinical findings common to both cases include the stature and

body proportions characteristic of arachnodactyly with generalized muscular hypoplasia and hypotonia. Each patient presented a high arched palate, dolichocephaly, a notable absence of subcutaneous fat, and presumptive congenital cardiac defects. One, a six-year-old white boy, had a large sella turcica and a dislocated ocular lens from a tremulous iris. The other, a fourteen-year-old Negro boy, gave a glucose tolerance test resembling that seen in hypopituitarism. The author attributes the entire syndrome to a defective mesodermal development consequent to primary inherited anterior pituitary dysfunction.

The relationship of epilepsy, migraine, and retinitis pigmentosa to arachnodactyly is outlined. A high, arched palate and disharmonious body development are common to all. The embryologic development of the pituitary, which arises from the roof of the mouth, and of the hard palate, the hypothalamus, and the optic system also point to an etiologic association of these entities. Duoparental inheritance factors were present in the author's first patient, both parents having high, arched palates, and the family history revealed other, less substantial but pertinent evidence of predisposition to pituitary dysfunction.

As further support for primary pituitary malfunction as a cause of arachnodactyly, reference is made to several autopsy reports which have revealed evidence of eosinophil hyperplasia.

Six roentgenograms; 6 photographs.

J. W. WILSON, M.D.
Indiana University

Syphilitic Osteoperiostitis—Skull, Ribs, and Phalanges. Report of a Case. John W. Metcalfe. U. S. Nav. M. Bull. **49:** 528–535, May-June 1949.

Although osseous syphilis is described as not uncommon in textbooks on pathology, it is rarely seen as a well developed osteomyelitis. The case here reported, with involvement of the skull, ribs, and phalanges, provided an interesting problem in differential diagnosis.

The patient, a 19-year-old male, reported for treatment in February 1947, complaining of headaches, malaise, and fever of two weeks duration. He had been treated with penicillin for gonorrhea during the previous year. On admission, multiple hard nodules were palpable over the cranial vault. There was a large tender mass arising from the tenth rib in the right anterior axillary line.

Roentgen examination of the skull showed several blurred, poorly defined osteolytic areas in the parietal bones. A degree of regional atrophy near these lesions accentuated the trabecular pattern of the outer table. No proliferative reaction was apparent. Fusiform swelling of the tenth rib with periosteal elevation and lamination was observed roentgenographically; irregular osteolytic areas were visible underlying the medullary area of the rib. Fusiform swelling of the right ring finger with periosteal thickening and pathological fracture of the mid-phalanx was evident. Upon the basis of the multiple osteolytic lesions and the finding of many plasma cells on biopsy of a rib lesion, a diagnosis of multiple myeloma was made.

Serologic tests for syphilis were positive on repeated examinations in March 1947. Specific treatment with 8,000,000 units penicillin over a ten-day period (making a total of approximately 14,000,000 units within one year), together with 0.49 gm. mapharsen, effected a clinical cure and reversed the serological reaction by June 1947. Roentgen re-examination showed a regression of the osteolytic process and some osseous proliferation about the periphery of the skull lesions.

In the differential diagnosis, primary and metastatic tumors, myelomatosis, tuberculosis, eosinophilic granuloma, yaws, leprosy, Paget's disease, scurvy, and osteomyelitis have to be considered. The combination of marked bone proliferation and minimal destruction frequently has led to the erroneous diagnosis of primary osteogenic sarcoma or Ewing's tumor. The multiplicity of lesions in syphilis, however, is strong evidence against such a diagnosis. Myeloma and metastatic lesions may be ruled out by their occurrence in the middle- and old-age group and by the more clear-cut osteolytic lesions. Myeloma especially shows no proliferative osseous reaction. Eosinophilic granuloma can be diagnosed by biopsy and exclusion of other causes for granulomata. Yaws was excluded in the present case because the patient had never traveled beyond Oahu. Radiologically, tuberculosis is predominantly destructive in character, with a minimal osteoplastic response. Bone lesions in leprosy are limited to the small bones of the extremities and show concentric absorption, characteristically, instead of periosteal thickening. Paget's disease may be excluded by the high phosphatase value. Osteomyelitis can be diagnosed specifically by bacteriological methods. For practical purposes scurvy is limited to infancy after the age of five months.

Three roentgenograms; 3 photomicrographs.

Hereditary, Multiple, Diaphyseal Sclerosis. S. Ribbing. Acta radiol. **31:** 522–536, June 30, 1949.

Ribbing reports 4 cases (among 6 siblings) of what he believes to be a hitherto undescribed entity. He has named this "hereditary, multiple, diaphyseal sclerosis." The disease is characterized by a diffuse osteosclerosis and hyperostosis involving the diaphyses of the long bones, especially of the lower extremities, with a tendency to symmetrical involvement. The changes advance slowly for a number of years but subsequently appear to become stationary.

Histologic examination of biopsy material in one case revealed cortical osteosclerosis involving principally the subperiosteal portion of the cortical layer. The new bone was exceedingly dense and fused without a line of demarcation into the normal bone. Haversian canals were very narrow. There were dense layers of calcification parallel with the surface.

The usual presenting symptom is pain, and there may be palpable thickening of the shaft of the bone. Symptoms did not appear before puberty in these cases. There were no systemic abnormalities present. Body development was normal. Bone marrow function was unimpaired.

Differentiation is made from other somewhat similar entities, on the basis of the hereditary feature and the histologic appearance.

Ten roentgenograms; 4 photomicrographs; 1 drawing.

HARRISON SHAPIRO, M.D.
Mt. Sinai Hospital of Cleveland

Calcium Deposits in the Vicinity of the Shoulder and of Other Joints. J. Albert Key. Ann. Surg. **129:** 737–753, June 1949.

The occurrence of calcium in the region of the shoulder is relatively frequent and is often associated

with stiff and painful shoulders, periarthritis and tendinitis, or subdeltoid or subacromial bursitis. Bosworth (J. A. M. A. **116:** 2477, 1941) found calcium deposits in one or both shoulders of 2.7 per cent of 6,061 unselected adults who were subjected to fluoroscopy. Calcium deposits in the vicinity of joints other than the shoulder are relatively rare, or at least have not often been reported. During the past ten years the author has encountered 20 such cases, distributed as follows: coracoid process, 1; elbow, 4; wrist, 3; hand, 4; hip, 4; knee, 2; foot, 2.

Wells (Chemical Pathology. W. B. Saunders Co., 5th Ed., 1924) states that calcification seldom occurs in normal tissue except in the formation of bone but that any area of dead tissue that is not infected and that is so large, or so situated that it cannot be absorbed, will probably become infiltrated with lime salts. Determination of calcium, phosphorus, and alkaline-phosphatase content of the blood in several of the author's patients with local calcium deposits failed to reveal anything abnormal, and this has been the experience of other observers. Consequently it is assumed that degeneration of the involved tendon or of the ligament or capsule of the joint preceded the deposition of calcium and that the primary cause of the trouble is the cause of this degeneration.

A fairly typical operative finding in an acute case is a dome-like swelling of the floor of the subdeltoid bursa, about 2.0 cm. in diameter, with a white apex or center surrounded by a purplish or red inflammatory zone, which shades off into the slightly inflamed floor of the bursa. When the apex of the swelling is incised, white or yellowish-white material of the consistency of tooth paste exudes on the floor of the bursa. In some hyperacute cases of short duration, the calcific material is thin or milk-like in consistency and may be under such pressure that it spurts into the air when the surface of the tendon is incised. In others the deposit may have ruptured into the bursa, which will be distended with a thin milky fluid. In chronic cases, the calcium deposit may be inspissated, forming one or more dry, chalky deposits which can be removed with a curette.

It is probable that these calcium deposits begin as microscopic precipitates of calcium salts, gradually increasing in size until they encroach upon the surrounding tissue and cause an inflammatory reaction there. Such a deposit may be present for months or even years and produce no symptoms and then suddenly, after an injury or without any known precipitating cause, may become the central point of an area of acute inflammation, with severe pain and disability. The reason for this is not known. Bosworth noted that the larger deposits (1.5 cm. or more in diameter) tend to cause symptoms and that the size of the deposit is in general in accord with the symptoms. Howorth (Surg., Gynec. & Obst. **80:** 337, 1945. Abst. in Radiology **46:** 203, 1946), however, states that large deposits may be almost symptomless, while small deposits may be associated with considerable pain.

The presence of a localized deposit of calcium in the tissues may be suspected, but the diagnosis is not made unless the material can be visualized in the roentgenogram. For the shoulder the author recommends films with the arm in internal and external rotation, as well as a vertical projection. Elsewhere the calcium can be shown roentgenographically with less difficulty and is usually visible in films taken in two planes. The margins of the deposit tend to be poorly defined and the density may be irregular. There is no evidence of internal structure, a fact which permits differentiation from bone.

The treatment of calcium deposits varies with the severity of the symptoms. In the absence of symptoms no treatment is indicated. If the deposit is causing sufficient pain and disability to lead the patient to consult a physician, treatment may be conservative or radical.

The conservative measures in use are: local heat, local cold, immobilization, exercise, sedatives, and deep roentgen therapy. Roentgen therapy has been used quite extensively during recent years and it is recommended by some as an almost infallible cure for calcium deposits in the musculotendinous cuff of the shoulder. The author has advised it for a considerable number of patients during recent years but does not consider himself in a position to make a statement concerning its efficiency. In some mild or moderately severe cases it has seemed to afford a measure of relief; in others it has had no apparent effect. In hyperacute cases with severe pain, it has not appeared to do any good. The same is true of chronic cases, and especially when there are severe capsular adhesions or contractions. In the latter the roentgenologist should restrain his enthusiasm or burns may result.

The more radical methods of treatment are manipulation under general anesthesia, needling, with or without irrigation, and operative exposure and removal of the deposit. The author reserves needling of a deposit for those patients in whom removal of the deposit is indicated but who do not wish to be operated on. This procedure is apt to be followed by a few days of severe pain and is not as reliable a form of treatment as is operative removal, which is the surest method of affording prompt and permanent relief.

Five roentgenograms; 10 photomicrographs.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Osteoporosis of the Pelvic Bones (Acute Bone Atrophy of Sudeck). Harold W. Bruskewitz and George H. Ewell. Am. J. Surg. **77:** 705–712, June 1949.

Osteoporosis of the pelvic bones is a clinical entity usually following surgery involving the urinary bladder. Pathologically it has been interpreted to be a low-grade infection by one observer, an atrophy of bone by another, while a third has described changes varying from a simple periostitis to an extensive necrosis of bone and cartilage. The authors regard it as a form of Sudeck's atrophy.

The disease follows a definite clinical course, with onset ten days to two months postoperatively. Pain over the symphysis pubis develops and extends to the perineum and inner aspects of the thighs. The pain is severe and produces a spastic state of the adductor and perineal muscles. The prognosis is always good, with ultimate complete recovery. Recalcification begins and new bone forms, with ankylosis of the symphysis after a period of three months to two years.

A mottled rarefaction of the pubis and ischial rami is revealed by x-ray examination. Due to the softening of the atrophic bone, the muscle pull of the tendinous insertions causes fraying of the periosteum and separation of bony fragments. In the differential diagnosis, simple periostitis is excluded because of the extensive decalcification of the bone and the absence of cortical

deposition of bone. The lack of sequestration speaks against osteomyelitis; complete cure rules out tuberculosis and bone tumors. In addition to osteoporosis, Paget's disease produces also osteosclerosis, which is not present in the condition under discussion.

The authors' cases were treated with deep x-ray therapy, alone in one case and with diathermy in another. Because of the rarity of the condition, data on the dosage and efficacy of radiation are still inadequate.

Six cases are presented, with 12 roentgenograms.

JOHN F. WEIGEN, M.D.
University of Pennsylvania

Dysplasia of the Hip: A Factor in the Development of Static Osteoarthropathy. Joseph Levitin. California Med. **70:** 401–406, May 1949.

Many theories have been advanced regarding the cause of dysplasia of the hip. Hart (J. Bone & Joint Surg. **24:** 753, 1942. Abst. in Radiology **40:** 621, 1943) is of the opinion that it is due to an increased acclivity of the roof of the acetabulum and that the hereditary factor is carried over from father to son. Badgley (J. Bone & Joint Surg. **25:** 503, 1943) attributes it to interference with the normal rotation of limb buds, with consequent increased anteversion of the femoral head and neck. He is of the opinion that such changes are still correctable in the first year of life by maintaining the extremity in abduction and internal rotation.

Diagnosis can be made with certainty only by x-ray examination. Two factors are involved: (1) The curve of the acetabulum is reduced and the upper part of the roof, instead of being directed horizontally, is directed upward. (2) The depth of the acetabulum is decreased, as evidenced by an increased width of the so-called "teardrop" shadow. There may also be a retarded development of the epiphyseal nucleus of the femoral head.

Patients with hip dysplasia may in later life complain of hip pain and fatigue, with x-ray evidence of traumatic arthritis. The changes must be differentiated from those of Perthes' disease and slipped epiphysis.

The author stresses the value of an early diagnosis since correct therapy in childhood may result in correction, while in later life a suitable occupation, with minimal trauma to the hip, may help prevent traumatic arthritis.

Eighteen roentgenograms.

MAURICE D. SACHS, M.D.
Cleveland, Ohio

Osteochondritis Dissecans of the Head of the Femur. Forrest L. Flashman and Ralph K. Ghormley. West. J. Surg. **57:** 221–228, June 1949.

Osteochondritis of the femoral head is an aseptic necrosis of a small portion of subchondral bone, usually on the superolateral aspect. It occurs predominantly in males. The authors' series of 21 cases included only 3 females. About two-thirds of their patients were over the age of thirty-six. In a single instance the disease was bilateral.

Although there is no history of injury in the majority of cases, the authors believe that subclinical trauma is the usual responsible factor, resulting in disturbance of the circulation and aseptic necrosis in that part of the femoral head which is subject to the greatest stress and strain, *i.e.*, the superolateral portion. Another theory which has been advanced is that the condition may result from a subchondral fracture, with rocking of the fragment in its bed, assuring non-union with consequent necrosis.

Following a symptomless latent stage, the patient complains of pain aggravated by weight-bearing. In a later stage osteoarthritis complicates the picture. Physical findings are limitation of motion, limping, and atrophy of the thigh.

Roentgen findings are typical. There is a dense, sharply defined elliptical area of bone which is frequently depressed below the rest of the head of the femur. The entire head was never involved in the series reported here, and free loose bodies were not seen in the joint. Changes due to osteoarthritis or revascularization may be superimposed.

The lesion consists of living cartilage (occasionally fibrillated) overlying dead bone, in which varying degrees of necrosis and revascularization may be seen. It lies in a cavity lined with fibrous tissue.

Therapy aims at revascularization and reattachment of the fragment. In severe cases drilling of the neck and underlying bone, and maintaining the contour of the head by elevating the depressed portion with bone chips is the treatment of choice. In advanced cases arthrodesis or arthroplasty may be necessary.

Three roentgenograms; 3 photomicrographs; 5 tables.

GABRIEL WHITEMAN, M.D.
University of Louisville

Classification and Treatment of Trochanteric Fractures. Harold B. Boyd and Lawrence L. Griffin. Arch. Surg. **58:** 853–863, June 1949.

A study of 300 trochanteric fractures of the femur was made to compare operative with non-operative treatment. Four types of fracture were distinguished: (1) a more or less linear break in the general direction of the intertrochanteric line; (2) fracture with the main break along the trochanteric line, plus comminution; (3) subtrochanteric fracture; (4) comminuted fracture with extension into the shaft. The most important factor in determining the prognosis was age; of 62 patients under fifty-nine years, none died. As age increased, a greater proportion died, and of the 9 in the tenth decade, 7 died. The proportion of operated to non-operated cases was about 2 to 1, the usual operation being fixation with a Jewett or Neufeld nail. Subtrochanteric fractures tend to migrate medially with this treatment, and in some a supplementary plate was used to prevent this. About 20 per cent of the patients operated upon experienced some type of complication, but on the whole the results were good and the authors, although making individual decision on the basis of the problem presented by each patient, tend to prefer operative immobilization. In the discussion, Dr. Kellogg Speed disagrees, preferring in general the non-operative treatment.

Eleven roentgenograms; 1 drawing; 5 tables.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Congenital Absence of the Patellae. Eugene R. Kutz. J. Pediat **34:** 760–762, June 1949.

The case is reported of a nine-year-old Negro girl with bilateral congenital absence of the patella demonstrable on inspection, palpation, and roentgenography. There was an associated genu valgum.

Bilateral absence of the patella is usually seen as part of the rare congenital and hereditary triad of patellar absence, dystrophy of the nails, and luxation of the head of the radius. It is unusual to see one defect alone, as in this case, since the underlying pathologic factors are so intimately related in the genes.

Two roentgenograms; 1 photograph.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Congenital Pseudarthrosis of the Tibia and Its Relation to Fragilitas Ossium. Report of a Case and Review of the Literature. F. Y. Khoo. Am. J. Dis. Child. **77:** 201–216, February 1949.

Pseudarthrosis implies the formation of a false joint, usually following a fracture, with no attempt at repair. Included under this term are permanent non-union and fibrous union following trauma producing abnormal mobility in bone. True joint formation is uncommon.

The author presents a case of congenital pseudarthrosis of the tibia in a boy of fifteen and reviews the subject with numerous references to the literature. He stresses the relation of trauma to congenitally defective bone in producing this condition. Among the etiologic factors mentioned by other writers are nutrient artery damage; deficiency of calcium, phosphorus, vitamins C and D; pathologic conditions of bone such as carcinoma or osteitis deformans; preponderant activity of fibroblasts over osteoblasts *in utero* or in childhood.

Roentgenographically, the involved bone presents a translucent space of varying width and direction separating the two diaphyseal segments. The adjacent ends of the bones vary in appearance from that of a well defined joint space to irregular margins of a fracture line. Histologically, the lesions show a fibroblastic reaction with varying degrees of sclerosis. Cartilage may or may not be present.

Treatment is often unsatisfactory because of the underlying congenitally defective bone.

Because of the many points of similarity between congenital pseudarthrosis of the tibia and the form of fragilitas ossium localized to the leg, it is concluded that pseudarthrosis of this type is in all likelihood a variant of fragilitas ossium.

Five roentgenograms; 2 photographs.

ALLEN TAYLOR, M.D.
Baltimore (Md.) City Hospitals

Leucemia in Childhood. A Clinical and Roentgenographic Study of Seventy-Two Cases. John H. Dale, Jr. J. Pediat. **34:** 421–432, April 1949.

This paper is an analysis of the findings in a group of 72 cases of proved leukemia in children. Although the incidence rate was only 0.42 per cent of all admissions to the pediatric service of the New York Hospital, this disease was the most frequently encountered malignant condition in children. It occurred most often during the first five years of life and was seen more frequently in females. After the fifth year, however, more males were affected. Approximately 96 per cent of the patients had the acute form of leukemia and in two-thirds of these the disease was of the lymphoid variety.

The symptoms and physical findings were protean, mimicking almost all childhood illnesses, often suggesting rheumatic fever.

Roentgenographic changes were noted in the long bones of 72.5 per cent of 40 cases. These changes consisted in (*a*) transverse radiolucent bands at the metaphyseal ends of the bones (93.1 per cent); (*b*) osteolysis (4.1 per cent); (*c*) periosteal elevation (2.4 per cent). Explanations for these changes and descriptions of the underlying histopathology are included.

Four roentgenograms; 6 tables; 1 chart.

STANLEY H. MACHT, M.D.
Hagerstown, Md.

Gaucher's Disease in a Negro. Report of Case. Roger M. Choisser and Robert R. Montgomery. Am. J. Clin. Path. **19:** 570–575, June 1949.

A case of classical Gaucher's disease in a full-blooded Negro woman, proved at necropsy, is reported. The entire clinical picture including laboratory and x-ray findings supported the diagnosis. The humeri appeared honeycombed and presented an unusual pattern of decalcification, and there was widening of the medullary canals. The progress of the anemia was slow, and death was caused by intercurrent tuberculous oophoritis and peritonitis.

Two roentgenograms; 3 photomicrographs.

Sickle Cell Disease Simulating Advanced Rheumatoid Arthritis. Report of a Case. Eugene L. Coodley and Morley J. Kert. California Med. **70:** 459–463, June 1949.

A case of sickle-cell disease in a 26-year-old Negro is reported, with bone and joint changes simulating advanced rheumatoid arthritis. Roentgenograms showed osteoporosis, irregular bony destruction, narrowing of joint surfaces, and osteosclerosis in the involved joints, principally the hip joints. It is felt that this picture is the result of many episodes of hemolysis with subsequent clumping or agglutination of sickle cells resulting in the formation of thrombi in the vascular channels to these joints. The end result is numerous bone infarcts with ischemia and the well recognized after-effects of bony destruction in an irregular pattern with repair by fibrosis. Typical bone changes in the areas surrounding the involved joints tended to corroborate the diagnosis.

Six roentgenograms; 2 photomicrographs.

Cooley's Erythroblastic Anemia in a Negro Girl. John D. Coffey, Jr., and David D. Salmon. J. Pediat. **34:** 621–625, May 1949.

Cooley's erythroblastic anemia has been described mainly in patients having a familial origin in Mediterranean countries. Cases have been reported, however, in an English child, in Chinese, in Indian, and in Negro children. The authors present another case with typical findings in a Negro girl. The child had the mongoloid face, large head, and enlarged heart, liver, and spleen characteristic of the disease. There was a marked anemia with many nucleated red cells, target cells, Howell-Jolly bodies, stippled cells, and Cabot's rings. The sickling test was negative. The icteric index was 14.4. Smears of the sternal marrow revealed marked hyperplasia of erythroid elements, the myeloid/erythroid ratio being 1/20. Roentgenograms of the skull showed typical thickening and striation of the diploe. The bones of the hands were expanded, with thinned cortices and prominent trabeculae. The cardiac shadow showed generalized enlargement.

Six illustrations, including 4 roentgenograms.

PAUL W. ROMAN, M.D.
Baltimore, Md.

THE SPINAL CORD

Pial-Medullary Angiomas. Clinicopathologic Features and Treatment. Robert C. Bassett, Max M. Peet, and John F. Holt. Arch. Neurol. & Psychiat. **61:** 558–568, May 1949.

Extradural and vertebral hemangiomas are readily recognized owing to their compression of the cord and the readiness with which they may be visualized in roentgenograms. Angiomatous anomalies of the pia-arachnoid and spinal cord characteristically present a less clear picture. As a result of seeming incongruity of the subjective and objective clinical signs, these lesions are routinely misdiagnosed in the early stages. The authors seek to show, through their presentation and discussion of 9 cases, that the lesions can be suspected and diagnosed clinically, and that with contrast roentgenography some of them can be diagnosed before operation.

Plain roentgenograms of the spine seldom reveal diagnostic changes. During myelography the contrast medium is dispersed and broken into columns which follow the topography of the angiomatous mass on the cord and pial surfaces. When well defined worm-like filling defects are seen in the opaque medium, a diagnosis of pial-medullary angioma can be made with reasonable certainty. One must be careful, however, to avoid misinterpreting a fortuitous arrangement of oil droplets or the longitudinal striations of normal blood vessels as an abnormal vascular pattern.

Angiomatous malformations seldom obstruct the flow of opaque media so completely as to suggest the presence of a more discrete extramedullary space-occupying lesion. Adhesive arachnoiditis with its irregular deformities due to pseudocysts and cicatrices may present a differential diagnostic problem. The picture of adhesive arachnoiditis is not uncommonly superimposed on that caused by an angiomatous malformation as a result of organizing hemorrhage from one or more ruptured anomalous vessels.

Grossly, these lesions present a tangle of pulsating vessels of varying diameter and length. There may be several large vessels up to 4 or 5 mm. in diameter, but the greater number measure from 1 to 2 mm. Frequently there is an associated arachnoiditis.

The treatment of these lesions is surgical removal. Total ligation, removal of the larger vascular elements, and cautious coagulation of the remaining vessels should be carried out as extensively as possible when the lesion is predominantly extramedullary. No attempt at palliative decompressive myelotomy should be made when a predominant mass of vessels is intramedullary. In such cases the dura may be left open for decompression. There was improvement in all the authors' patients except those whose lesions were predominantly intramedullary and those who had extensive long-standing cicatricial arachnoidal adhesions.

High-voltage roentgen therapy is recommended by some when wound healing is well established. Whether any therapeutic effect is actually induced by irradiation, the authors are not prepared to state. It must be borne in mind that normal vessels in the spinal cord may be adversely affected by irradiation in sufficient dosage to destroy the abnormal vessels in this type of angioma.

Five roentgenograms, with accompanying drawings.

J. R. HANNAN, M.D.
Cleveland Clinic Foundation

THE BLOOD VESSELS

(See also under The Head and Neck; The Chest)

Fat Embolism. J. E. Dunphy and Frederic W. Ilfeld. Am. J. Surg. **77:** 737–743, June 1949.

For the development of fat embolism three conditions are necessary: (1) liquid fat free in the tissues, (2) torn and patent veins, and (3) an increase of local tissue pressure above the level of the venous pressure. Such factors may occur following fractures, blast injuries, burns, surgical operation, and extensive contusion of subcutaneous tissue. Fat emboli may be distributed to organs throughout the body, but death is due predominantly to involvement of the brain or lungs. It has been suggested that the occlusion of blood vessels may have a specific toxic effect, quite apart from mere occlusion of the vessel, and this view is supported by experimental studies, showing that the neutral fat necessary to produce death in experimental animals exceeds the estimated amount in the marrow of the femur in man. Also, it has been found possible to produce a remarkable tolerance to fat in animals, by repeated injections of less than the minimal lethal amount. Hydrolyzed human fat is more toxic than neutral fat.

Fat embolism can be demonstrated pathologically in about 50 per cent of fatal injuries. In about 25 per cent it is a contributing cause of death.

The presence of fat embolism is to be suspected (1) following injury to bone, especially fractures of the tibia and femur, and excessive soft-tissue injuries; (2) a free interval, varying from a few hours to nine or ten days, between injury and the onset of symptoms; (3) pulmonary or cerebral symptoms, or both, plus petechial hemorrhages in the skin and mucous membranes. X-ray examination of the chest on the first day after the onset of embolism will show a diffuse haziness and cloudiness of the lung fields which persist many days after the lung symptoms have gone. Fat should be sought in sputum and urine, after thirty-six hours and five days, respectively.

High concentrations of oxygen administered by a closed BLB mask, plus chemotherapy and blood as indicated, have occasionally proved useful.

Three roentgenograms.

JOHN M. PHILLIPS, M. D.
University of Pennsylvania

Deep Vein Thrombosis in a Newborn Infant. Maurice J. Keller. J. Pediat. **34:** 482–486, April 1949.

Keller reports a case of thrombosis of the deep veins of the right lower extremity in a nine-day-old infant and comments on the probable etiology and associated pathologic changes. The case is of interest because there were no demonstrable local or systemic signs of infection and because venography in this age group has not previously been reported.

The patient was admitted to the hospital thirty-three hours after a ritual circumcision, in which excessive manual pressure was applied to the inguinal regions. On admission there were signs of venous obstruction in the deep veins of the right lower extremity, with no femoral pulsation. The rectal temperature was normal. Blood studies showed 20,000 white cells with 65 per cent polymorphonuclears.

There was rapid improvement on heparin therapy and venography was performed *via* a cannula in the right external saphenous vein. The venogram showed

no filling of the deep venous system of the lower extremity, a filling defect at the junction of the femoral and saphenous veins, and many tortuous collateral veins. This confirmed the diagnosis of venous thrombosis, with vasospasm as a complicating factor, due to trauma.

One phlebogram.

HARRY W. BANKER, M.D.
Baltimore (Md.) City Hospitals

GYNECOLOGY AND OBSTETRICS

Hysterogram in the Diagnosis of Uterine Bleeding. David J. Wexler, Charles H. Birnberg, and Lawrence Kurzrok. Am. J. Surg. **77:** 755–760, June 1949.

The indiscriminate use of hormone injection therapy for abnormal uterine bleeding is to be condemned, as it is not without danger. An accurate diagnosis should first be established by complete physical examination plus other studies and a curettage if necessary. Routine hysterography with innocuous, non-oily rayopake in amounts of 1.5 to 3.0 c.c., thus diminishing likelihood of oil emboli, is suggested as an important diagnostic measure in all cases in which clinical examination has failed to reveal the cause of bleeding. A scout film is taken followed by films after 1.5 c.c. and 3.0 c.c. have been injected. A radiolucent plastic bivalve vaginal speculum and a uterine sound marker are used. Of 104 consecutive patients studied by this procedure, the findings were normal in 24; 34 had endometrial polyps; 28 fibroids; 11 hypertrophic endometritis; 1 a missed abortion; 1 cervical carcinoma invading the uterine cavity.

Hysterography is contraindicated in the presence of acute inflammation and bleeding in early pregnancy.

Nine roentgenograms; 2 photographs.

JOHN M. PHILLIPS, M. D.
University of Pennsylvania

Hysterosalpingography with 70 Per Cent Joduron. Casimiro Simonetti and Mainardo Tomiselli. Radiol. med. (Milan) **35:** 496–499, June 1949. (In Italian)

Joduron is an Italian preparation used for intravenous urography. The authors have employed a 70 per cent concentration of this dye to outline the uterus and tubes. The resulting radiographs are excellent and it is pointed out that the dye is without danger in the event of accidental intravasation and is easily reabsorbed by the peritoneum without causing localized secretions.

Five roentgenograms.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Measurement of the Anterior Obstetrical Sagittal Diameter. John C. McDermott. West. J. Surg. **57:** 245–251, June 1949.

The author believes that direct pelvimetry is being neglected in favor of x-ray pelvimetry. He considers direct measurement of the internal conjugate sufficiently accurate. Moreover, a trial of labor, which will give the best evaluation of the size of the inlet, can be safely carried out here. Beyond the pelvic inlet, however, trial of labor becomes hazardous and direct measurement is especially desirable. X-ray study in this area has not been extensive because of the difficulty of photographing and interpreting the varying angles and planes.

The author presents a new direct measurement which he terms the "anterior sagittal diameter." When the head is crowned, it is caught under the pubic rami where they diverge to a distance of 8 cm. The anterior sagittal diameter is the measure of the distance from the mid point of a line between the pubic rami where they diverge to this extent to the upper border of the symphysis. As this distance increases above 9 to 10.5 cm., the head is pushed further backward to where the cross section of the pelvis is decreased by the presence of the ischial spines, and difficulty may be expected. Above 11.5 cm., abdominal delivery is usually required.

A simple instrument is described for measurement of the anterior sagittal diameter, and diagrams are presented to illustrate the use of the measurement.

Five illustrations.

GABRIEL WHITEMAN, M.D.
University of Louisville

Detection of Foetal Abnormalities. J. Blair Hartley. Proc. Roy. Soc. Med. **42:** 301–310, May 1949.

The detection of fetal abnormalities and the evaluation of abnormal appearances demand of the radiologist precision radiography, much experience, and persistent study of normal pregnancy at all stages. Precise and meticulous radiographic technic is essential. The woman should be examined in the recumbent position and a compression band used. An anteroposterior film is taken and examined at once in the darkroom. Further views are made depending on the position of the fetus.

Study of the size, tone, and stage of development of the fetus may reveal a multiplicity of abnormalities. Determination of the relationship of the fetus to the maternal pelvic canal may aid in the diagnosis of placenta praevia and of extrauterine pregnancy. Abnormalities of presentation may be caused by various fetal malformations.

The demonstration of fetal abnormalities should not be confined to antenatal studies. X-ray studies of the newborn infant can reveal the nature and extent of skeletal defects in a manner which no pathologist can emulate. There is a large field awaiting the combined investigation of the pediatrician and radiologist.

Five roentgenograms.

DONALD S. CHILDS, JR. M.D.
The Mayo Foundation

THE GENITO-URINARY SYSTEM

Vasomotor Response to the Intravenous Administration of Neoiopax for Urograms. R. V. Daut and J. Hartwell Dunn. J. Urol. **61:** 1094–1098, June 1949.

The subjective response to neo-iopax injection is universally recognized. The objective response is less well known. The authors present the blood pressure fluctuations occasioned by the injection of 30 c.c. in 100 patients. The following observations were made:

1. A transitory slight drop in pressure occurred during and shortly after injection.
2. Subsequently the pressure rose above normal by an unpredictable amount.
3. There was no correlation between the blood pressure fluctuation and subjective symptoms.
4. There was no correlation between blood pressure fluctuation and age.
5. The average pressure rise was 26.1 mm. mercury.

The authors consider neo-iopax injection to be practically innocuous. The group of cases reported here is part of a series of 15,000 in which neo-iopax was used for urography with only one fatality.

Five tables.

NORVAL F. ZIMMERMAN, M.D.
University of Pennsylvania

Roentgenographic Observation of Perforation of the Kidney Following Retrograde Pyelography. A. Druckmann and S. Schorr. J. Urol. **61:** 1028–1031, June 1949.

Injury to the kidney during retrograde pyelography is either due to excessive pressure or direct instrumental perforation. In the majority of cases a pathological condition already exists. The authors have found that the extravasated contrast medium produces a characteristic shadow in many cases, showing a sharp, well defined, convex lower border and an ill defined, horizontal upper contour.

Four case reports are included, with 5 roentgenograms.

JACK EDEIKEN, M.D.
University of Pennsylvania

Solitary Renal Ectopia and the Nephrotic Syndrome. Ralph H. Kundstadter and Irving J. Shapiro. J. Pediat. **34:** 470–477, April 1949.

A case of solitary pelvic ectopic kidney observed in a 21-month-old infant is reported. Congenital ectopic kidney is seen once in 600 to 800 autopsies. A solitary pelvic ectopic kidney is rare, only 36 cases having been reported in the literature.

The authors' patient was first seen with a nephrotic syndrome which was considered to be due to glomerulonephritis following previous upper respiratory infections and allergic phenomena. The history and laboratory findings are presented in detail. A large movable left lower abdominal mass was present and it is suggested that, since a previously negative urinalysis became positive for albumin after the mass was massaged, this represented kidney. An intravenous pyelogram revealed renal filling only in the lower left portion of the abdomen. Cystoscopy and a retrograde pyelogram revealed a normal left ureteral orifice and an ectopic, slightly hydronephrotic left kidney with a subpelvic ureteral narrowing. There was a dimple at the site of the right ureteral orifice which would not admit a bougie or catheter.

The finding of a single pelvic renal ectopia with hydronephrosis and ureteral stenosis was confirmed by surgical exploration. Unfortunately a renal vessel attached to the left external iliac artery militated against a corrective procedure. The ectopic kidney was about the size of two normal kidneys.

The authors believe exploration is justified in these cases to correct the condition or coexisting anomalies, which are often present.

Four roentgenograms; 1 photograph; 2 tables.

HARRY J. PERLBERG, JR., M.D.
Baltimore (Md.) City Hospitals

Embryoma of Contralateral Kidney Ten Years Following Nephrectomy for Wilms' Tumor. Joseph A. Ritter and Earl S. Scott. J. Pediat **34:** 753–757, June 1949.

The authors report a case of Wilms' tumor developing in the remaining kidney ten years following the removal of the contralateral kidney for the same cause.

An infant of six months had a large abdominal mass which on removal proved to be a Wilms' tumor (embryoma) of the right kidney. Ten years later, a mass developed in the left abdomen. Intravenous pyelograms showed marked distortion of the pelvis and calyces, which were displaced downward and anteriorly. X-ray therapy was given for "a total of 6,400 roentgen units to the tumor." The dosage scheme and factors are not given. Nine months after x-ray therapy was begun, the tumor was no longer palpable but the patient was admitted to the hospital with uremia, severe hypertension, and cardiac enlargement. Death occurred shortly thereafter.

Postmortem studies of the kidney showed an enlarged organ with a large mass presenting central necrosis and extensive fibrosis. "The cellular elements often seen in this type of tumor were no longer evident." There was severe nephro-arteriolar sclerosis. The reduction of the tumor was ascribed to the radiation, which was also believed to have contributed to the renal changes leading to the death of the patient.

The second tumor was thought to be independent of the first, *i.e.*, not a metastasis.

One roentgenogram; 2 photomicrographs.

CORNELIUS COLANGELO, M.D.
Chicago, Ill.

Post-Caval Ureter: Report of Case. Jack W. Schwartz and Nelson S. Irey. Urol. & Cutan. Rev. **53:** 327–329, June 1949.

A case of postcaval ureter is presented, said to be the thirty-ninth in the literature and the fifth to be diagnosed preoperatively. Retrograde pyelography showed the characteristic finding of a sickle-shaped ureteral curve overlying the vertebral column in the region of the third and fourth lumbar vertebrae with dilatation of the ureter above this point. An associated infarction of the kidney due to thrombosis of the renal vein was responsible for the symptoms—severe right hypochondriac and costovertebral pain, with nausea and vomiting—which led to examination. There was also an unexplained fibrosis of the proximal ureter and renal pelvis.

Six illustrations, including 2 pyelograms.

Roentgen Kymography in the Study of Vesico-Ureteral Reflux. Ayres de Souza. J. de radiol. et d'électrol. **30:** 362–365, 1949. (In French)

A review of the rather confusing theories of the mechanism of production and the pathologic physiology of vesico-ureteral reflux is first presented.

The author has studied this phenomenon by filling the bladder with a liquid contrast medium and obtaining roentgen kymograms during urination. He has demonstrated in this manner transitory refluxes which were not present on films secured before or after urination. These refluxes were seen at almost any time during urination, at the onset, during, or at the end of the act. They were associated with various types of disease, such as hypertrophy of the prostate, diverticula of the bladder, neoplasms, etc. In almost every instance the involved ureter gave evidence of hypoperistalsis. Also occurring frequently was a disordered and irregular type of contraction of the urinary bladder with segmental areas of contraction and dilatation instead of the expected smooth and uniform contraction of the entire bladder.

The author suggests that this method may well be of value in the study of the vesico-ureteral reflux.

Fifteen roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

Müllerian Duct Cysts. Ralph R. Landes and Charles L. Ransom. J. Urol. **61:** 1089–1093, June 1949.

The authors present the fifteenth case of müllerian duct cyst to appear in the literature, and the third to be diagnosed by passing a catheter into the utricle cystoscopically and injecting a contrast medium which outlined the cyst roentgenographically.

A persistence of the müllerian duct in the male may occur anywhere in its course and produce a cyst. The larger cysts are found at the utricle, which is the fused portion of the müllerian system, occurring between the bladder and the rectum and just above the prostate.

Müllerian duct cysts are usually seen in young adults and produce symptoms of bladder neck obstruction. All of these cysts may be palpated rectally. At times they give rise to abdominal pain.

The authors review the treatment in the reported cases and conclude that complete excision is not necessary. In their case the cyst was emptied through the utricle by rectal massage and they believe this measure is worthy of trial where it can be carried out.

Three roentgenograms. JACK EDEIKEN, M.D.
University of Pennsylvania

TECHNIC AND APPARATUS

Some Recent Results with My Kymographic Method (Multiple Centers Rotating Kymography). Mario Lenzi. Acta radiol. **31:** 358–370, April 30, 1949.

Following the observation that a single rotating kymogram made with a fixed or mobile grid, using either parallel or radial slits, resulted in an incomplete delineation of organs with curved borders, the author has modified the technic which he described in 1946 before the Academy of Sciences in Ferrara.

When the kymograph was centered on a point corresponding to the center of an organ such as the heart, diaphragm, or urinary bladder, it was found that the movement of the curvilinear borders was outlined only in part, even though a radial grid was utilized. If one or more kymograms were made of an organ, using the same center for each, the movements of only that portion of the contour having the same curve as that of the rotating center of the kymograph would be recorded accurately. A new method was therefore devised using multiple centers, recording each arc of the silhouette by a separate center, employing either a rotating grid with radial slits 2 mm. apart or a fixed radial grid and a rotating film holder. This modification has been termed "multiple centers rotating kymography."

This method, as outlined, consists first in the making of a preliminary radiographic and fluoroscopic survey of the organ to be studied. During the fluoroscopic examination, the contour of the organ is sketched on the fluoroscopic screen. The various portions of the silhouette are then divided into arcs and the centers of these separate arcs are used as the centering points for the multiple kymographic studies. The centers, as determined either by direct observation, geometric methods, or statistical methods, are marked on the patient. The speed of the moving grid or film holder has been previously determined and is directly proportional to the speed of movement of the part to be examined. A preliminary kymogram is then made, which is followed by the making of a number of rotating kymograms, one for each curve of the contour, using as a center for each kymogram one of the points previously marked on the patient.

The results of this method in the study of the movements of the diaphragm, urinary bladder and heart, both under normal and pathologic conditions, are described and the advantages of the new technic are compared with the author's previous method and the Stumpf method. With the Stumpf method, the movement of the peripheral portion of the diaphragm is not accurately recorded, whereas with the multiple centers rotating kymographic technic the motion of both the central and peripheral portions are recorded. The multiple centers rotating kymographic method is considered more suitable also for the study of bladder function, since the contraction of the bladder wall is not concentric during emptying. Minor changes in this contraction due to localized disease of a portion of the bladder are demonstrated by the author's method. The movements of the cardiovascular shadow are recorded and the various segments of the silhouette have been investigated as to amplitude and time relationship both in normal and pathologic hearts.

Eighteen illustrations. JACK WIDRICH, M.D.
Cleveland City Hospital

Microradiography. Arne Engström. Acta radiol. **31:** 503–521, June 30, 1949.

The technics of microradiography and a review of the pertinent work on the subject are presented, following which the possibilities and applications of "quantitative" microradiography are discussed.

Quantitative microradiography, by means of a continuous spectrum, makes possible the determination of the mass (weight) of cellular structures with diameters of as little as 1μ. The author's method consists of using low voltage (500–400) continuous spectrum radiation to make a radiograph of a small specimen mounted on collodion foil. One part of the mount contains an absorption wedge of thin collodion foils. The resultant radiograph, on a fine grain film, is enlarged several hundred times and photometric measurements of the absorption of the radiation in the specimen and the step wedge are made. The mass of the test object can then be calculated.

Differential chemical analysis of a specimen can also be made by microradiography. This is based upon the fact that in the roentgen absorption spectrum of the elements there appear, at wave lengths characteristic for each element, absorption discontinuities, or "jumps." Monochromatic radiations, one of which is of slightly shorter, and the other of slightly longer wave length than the K absorption line of the element in the tissue under analysis, are used. By the absorption measurements, the "jump" can be estimated, and since this is proportional to the amount of the element present, the quantity of the latter can be calculated. The mathematical formulae and their derivation are presented and the apparatus is described.

The article is highly technical and should be read in the original by those interested in the subject.

Nineteen illustrations; 2 tables.

ALBERT BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

An Easily Sterilizable, Flexible Cassette with Intensifying Screens, Designed for X-Ray Examination of Operatively Exposed Kidneys. Olle Olsson. J. Urol. **61:** 1032–1033, June 1949.

An article by the author covering essentially the same material appeared in Acta radiologica **30:** 91, Aug. 31, 1948, and was abstracted in Radiology **53:** 150, 1949.

One illustration.

The Approach to the X-Ray Film. Karl J. Myers. West Virginia M. J. **45:** 133–136, June 1949.

Limitations of roentgen diagnosis in general are discussed, along with an outline of how to get the most information from an x-ray examination. The article is written especially for general practitioners and specialists other than roentgenologists and contains nothing new. Emphasis is placed on regarding the roentgenologist as a consultant and making available all pertinent information. The object of the author is not to make radiologists out of his fellow physicians but to stimulate their interest in the method.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Persistence of Fluoroscopic Screens. Willard W. Van Allen. Pub. Health Rep. **64:** 560–573, May 6, 1949.

Light emission from phosphors such as are used in fluoroscopic or intensifying screens is of two types: fluorescence during excitation and phosphorescence after excitation. Continued emission of light for an appreciable time after cessation of the exciting radiation is known as persistence. This is negligible in intensifying screens but quite variable in screens used for fluoroscopy or photofluoroscopic work (See Pub. Health Rep. **61:** 1583, 1946. Abst. in Radiology **49:** 526, 1947).

Experimental methods for determining the degree and rate of decay of persistence of phosphorescent emission from fluoroscopic screens are described. Persistence was found to increase with the intensity (and length) of excitation. The effect of both single and repeated exposures was studied and the data are presented in graphic form. Limits of tolerance are discussed from the standpoint of fogging, with special reference to cineroentgenography. In most cases it was found advisable to have the film remain in place 0.1 second after the exposure was completed.

Two drawings; 8 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Characteristics of Commercial X-Ray Screens and Films. V-X. Willard W. Van Allen. Pub. Health Rep. **64:** 581–582, May 6; 706–707, June 3; 847–848 July 1; 979–980, Aug. 5; 1124–1125, Sept. 2; 1560–1561, Dec. 2, 1949.

Further reports evaluating the characteristics of commercial films, screens and developers in appropriate combinations (See Abst. in Radiology **52:** 771, 1949).

RADIOTHERAPY

A Study of the Failures in Contact Roentgen Therapy of Skin Cancers. P. Chatton J. de radiol. et d'électrol. **30:** 251–260, 1949. (In French)

Among 137 cases of skin cancer treated by contact irradiation the author had 22 failures of cure following the initial treatment series. In most of the cases, healing was eventually obtained by additional treatments. The histologic type of cancer proved to play little or no part in prognosis. Except for cancers of the trunk and extremities, which proved slightly more refractory to treatment, the location of the cancer was also of no importance. Contrary to the experience of many other authors, lesions previously treated responded as well as those treated for the first time.

The author believes contact therapy to be the ideal procedure in skin cancers of small dimensions. It is not only the simplest and neatest method of treatment, but the most precise. No other method can claim such accuracy in the limitation of a radiologic lethal dose to the chosen volume of tissue. But this advantage is restricted strictly to those tumors whose size does not exceed the field of radiation produced by the apparatus. Furthermore, the peripheral zone of tissue around the tumor must be included in this estimate. Practically this signifies a field 1.5 cm. in diameter; beyond this field the dosage rate drops to below 20 per cent. Within these limitations, the author has experienced no failures, no recurrences, and no radionecrosis; the scars are healthier, less achromic, and less atrophic than with other methods.

The failures were thus chiefly in large lesions, especially those which necessitated multiple fields. In the larger tumors treated by a single field, recurrences were found at the periphery, while in those treated by multiple overlapping fields areas of overtreatment and undertreatment were seen, resulting even in recurrences combined with radionecroses. The author pleads for a greater variety of treatment cones for more exact localization of treatments, as he has found lead rubber shields difficult to handle because of slipping. The apparently healthy zone of tissue surrounding the lesion must be treated adequately, preferably with a filter of 1 mm. Al. At the periphery of lesions exceeding 1 cm. in diameter, the dose is 10 to 20 per cent less than in the center and must be adjusted correspondingly. The author also recommends exceeding the lethal dose by 20 per cent to insure prevention of recurrences.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Lead-Containing Clay for Shielding in Roentgen Ray Treatment of the Skin. Robert Kaldeck. Arch. Dermat. & Syph. **59:** 665–666, June 1949.

Lead foil and rubberized lead sheet, the conventional means of shielding the skin from roentgen rays, are stiff so that they do not fit closely to elevations and depressions; on the face and on the fingers particularly, they tend to move, even after being fastened with adhesive tape. The following lead-containing clay has been compounded which does not have these disadvantages:

	Per cent (by weight)
Fine lead powder	77
Petrolatum U.S.P.	9
Plastic clay (as used in toy sets)	5
Talcum powder	9

The mass is slightly harder than soft putty, easily molded at room temperature, non-elastic, and non-

resilient. With the use of a round pencil as a rolling pin, any thickness can be produced easily. An opening the approximate shape of the area to be treated is then cut out with a pocket knife. After application of the clay to the skin, the opening is checked and desired changes are made by slight pressure. When a treatment cone with a large opening is used, lead foil or rubber can be employed and clay can be used to narrow the opening to the desired form.

Tests have shown that a 1/16 inch (1.5 mm.) thickness of the clay has protective power equal to that of the same thickness of lead foil or rubberized lead. For easier handling, however, a 3/16 inch (4.5 mm.) thickness is recommended.

One illustration.

Carcinoma of the Breast. Present Status of Therapy. Howard W. Jones, Jr. Am. J. Surg. **77:** 696–704, June 1949.

This paper reviews the present status of the treatment of carcinoma of the breast with special reference to the various adjuncts to its operative treatment, such as preoperative and postoperative irradiation, prophylactic and therapeutic castration, and prophylactic and therapeutic androgenic therapy. The author reports on the findings in 221 ward cases from the Johns Hopkins Hospital treated by radical mastectomy from 1932 to 1942 inclusive. He also quotes statistics from numerous other authors.

The average patient with cancer of the breast should be subjected to immediate radical operation without preliminary irradiation. In inoperable cases or those of borderline operability, irradiation, alone or combined with surgery, has much to offer, including the possibility of a five-year cure. The over-all five-year salvage of the author's cases was 74 of 221, or 34 per cent. He could find no statistical difference between the group receiving postoperative roentgen therapy and the group treated only by operation. The survival time in cases in which the patients succumbed within five years did not differ in the two groups. For this reason, it is felt that nothing is to be gained from the routine use of postoperative prophylactic roentgen therapy.

From theoretic considerations and from a review of the literature, there is reason to believe that routine prophylactic castration, particularly in the child-bearing age, is to be seriously considered in the treatment of breast cancer. This procedure prevents pregnancy which, in some instances, is associated with widespread metastasis following radical breast surgery.

Androgens play an important role in otherwise hopeless breast cancer, but the author recommends their use only in those cases not suitable for roentgen therapy or in cases of roentgen failure.

Three illustrations; 5 tables.

JOHN W. HOPE, M.D.
University of Pennsylvania

Roentgen Therapy Alone in the Treatment of Operable and Non-Operable Cancers of the Breast M. Baclesse. J. de radiol. et d'électrol. **30:** 323–328, 1949. (In French)

Detailed statistical analyses are given of 130 cases of breast carcinoma of all types and in all clinical stages of evolution. All of these cases were treated by roentgen therapy exclusively. Biopsy was done in 78 cases. The technic used was very meticulous, utilizing six or seven fields at the onset of treatment with a smaller number at the end of the series. The treatments furthermore involved a long period, as a rule three to four months, and consequently proved to be rather expensive. Because of the large doses administered, an extreme degree of care in the positioning of the small fields and the spacing of treatment was essential, necessitating skilled technical personnel familiar with the problem of avoiding complications. The tumor dose calculated at the center of the nipple averaged 7,500 r, with extremes of 4,100 r and better than 9,000 r. The tumor dose to the axillary nodes averaged between 6,000 and 7,000 r, with the skin dose in the supraclavicular areas usually ranging between 4,500 and 5,200 r. The apparatus at 180 kv. and 60 cm target-skin distance delivered 20 r per minute through 1 mm. Cu filtration and 10 × 10-cm. cones.

Under these conditions, 32 per cent of 130 patients in all stages of tumor development are clinically free of cancer after three years, and 16 per cent of 52 cases followed for five years show no evidence of cancer.

The author considers this work as experimental. So far he feels encouraged by the results obtained in the anatomic area usually treated by surgery. He makes no claim as to the influence of this method in the prevention or treatment of distant metastases to bones, lungs, liver, etc., just as surgery considers this problem as being outside its field.

Ten tables.

E. M. SAVIGNAC, M.D.
Detroit, Mich.

Roentgen Therapy of Carcinoma of the Breast by Long Focal Distance Irradiation. R. Nadal, P. Denoun, and J. Beix. J. de radiol. et d'électrol **30:** 261–262, 1949. (In French)

The authors detail the technic of roentgen therapy of breast cancer at the Hôtel-Dieu in Paris for the past two years. They attempt in a relatively short period of time to treat through a single or double field the breast and its entire area of lymphatic drainage. At 200 kv. and 18 ma., a dose of 250 r is delivered in nineteen minutes with a filtration of 1 mm. Cu and 2 mm. Al at a target-skin distance of 80 to 90 cm. The patient lies on her back with the arm elevated to open the axilla, and the head turned to the healthy side. Lead rubber protectors are placed over the head, over the healthy side of the chest, parallel to the sternum, and over the liver and spleen. The irradiated field includes the breast, the axilla, the supraclavicular and infraclavicular areas, the submammary and the internal mammary lymphatic chains.

In preoperative therapy no attempt at administration of a lethal dose is made; the aim is to produce a rapid lymphatic blockage and to mobilize tumors which are beginning to adhere to the chest wall. The preoperative patients seen fall into two main groups:

1. Those with cancers adhering to the skin and partly fixed to the deep structures with movable axillary nodes. These have received over a single anterior field doses of 200 r triweekly to a total of 2,600 r. Operation is performed one month after the end of the series. The surgeons have stated that the tumor is then easily removable without appreciable skin reactions or any deleterious systemic effect.

2. Those with clinically inoperable tumors with extensive adenopathies, marked fixation, and frequently with ulceration. In these instances the total dose is

elevated to 3,000 r and occasionally to 4,000 or 4,500 r. The treatments are then given over an anterior and a posterior symmetrical field, again three times a week, with 200 r per session. This double field prevents skin damage while increasing the tumor dose. Frequently the patient then presents an operable tumor; if not, the dose is increased to 6,000 r (3,000 r on each field) and the series is repeated in six months.

Postoperatively the patients have all received 2,500 to 3,000 r on each of two fields, an anterior and a posterior, under the same treatment plan as above, frequently repeated in six months.

Many patients are also castrated by roentgen rays and given male hormone therapy. All receive antianemia therapy. No excessive blood depletion or pulmonary fibrosis has been observed to date nor have there been any severe skin reactions.

It is still too early to predict the value of this plan of therapy as compared to other methods, but it appears to promise good results. E. M. SAVIGNAC, M. D.
Detroit, Mich.

On the Occurrence of Herpes Zoster in Carcinoma of the Breast. Eugene P. Pendergrass and David Kirsh. Am. J. M. Sc. **217:** 674–680, June 1949.

This article presents a group of 16 cases of herpes zoster encountered among 406 cases of carcinoma of the breast seen at the University of Pennsylvania Hospital between 1932 and 1949. In 12 of the cases there was evidence of metastatic disease either before or after the appearance of the cutaneous lesion. The remaining 4 patients survived between six and twelve years after the herpetic attack with no evidence of metastatic growth.

Abstracts of the case histories of all sixteen patients are presented in abbreviated form. The clinical information is also tabulated.

On the basis of large surveys, herpes is said to occur in the proportion of 1 to 2 per cent of all diseases of the skin, while in a ten-year period it was observed in 0.06 per cent of 200,000 admissions to Bellevue Hospital in New York.

The authors conclude that herpes zoster occurs in relatively high incidence in carcinoma of the breast, especially in those cases showing metastatic disease. Most of the patients developing herpes had been subjected to roentgen irradiation, but the etiological significance of irradiation and metastases has not yet been clarified. HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Malignant Lesions of Nasal Fossae and Sinuses. Diagnosis and Treatment. Austin T. Smith and Theodore P. Eberhard. Pennsylvania M. J. **52:** 932–936, June 1949.

Early cancer of the antrum is seldom seen because it rarely causes symptoms until it begins to erode through the bony wall and adequate excision would require removal of a portion of the base of the skull. Cancer of the nose also causes very little discomfort until far advanced. Its appearance may be like that of the more common polyp and it may even be surrounded by polyps. Care must be taken that a biopsy is deep enough to secure malignant tissue.

At least 90 per cent of malignant lesions of the nasal fossae and sinuses are inoperable when first seen, so that resort must be made to irradiation therapy This necessitates a knowledge of adequate tumor dosage, some knowledge of pathology, meticulous attention to technic, and the courage to treat many hopeless cases for the sake of the occasional long-term arrest.

Epitheliomas and lymphosarcomas are suitable for radiation treatment; fibrosarcoma rarely responds at all. On a statistical basis, radiosensitivity varies according to the degree of differentiation, but when one considers the individual case he must disregard these probabilities.

On the basis of a ten-year survival, it must be concluded that radiation is rarely if ever of value, and no series of cases shows better than 20 per cent five-year survivals; but if we can hope to keep some of these patients symptom-free for six to twelve months the treatment is worth while. Without treatment, the history of these patients is one of increasing misery until death.

Any treatment, to be effective, must be intensive. No one can say what an adequate dose is, but the authors believe at least 5,000 tissue roentgens is necessary to control an average tumor, and if the patient can be treated only once or twice a week, even 7,000 or 8,000 r may be ineffective.

Hospitalization and the combined efforts of the otolaryngologist and radiologist are necessary to keep the mucous membrane from breaking down, as even 2,000 r given in a few days may cause necrosis of normal tissue.

Three illustrations. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Carcinoma of the Nasopharynx. Report of 150 Cases. Marvin W. Simmons and Irving M. Ariel. Surg., Gynec. & Obst. **88:** 763–775, June 1949.

The author reports here a series of 150 cases of nasopharyngeal carcinoma and briefly reviews the anatomy and lymphatic drainage of the nasopharynx and the pathology of nasopharyngeal carcinoma.

The fact is emphasized that nasopharyngeal carcinoma develops insidiously and rarely presents initial symptoms due to the primary growth itself. The disease is usually heralded by symptoms from cervical metastases and from intracranial extension. Cervical metastases occurred in 87 per cent of the patients in the present series, and neurologic symptoms due to pressure on cranial nerves by intracranial extension in 36 per cent.

The correct diagnosis was not suspected by the referring doctor in 62 per cent of the 150 cases, and in 13 per cent operations such as tonsillectomies, mastoidectomies, incision and drainage of neck abscesses, etc., had been performed.

Treatment was exclusively radiological. Fractionated roentgen irradiation at 200 to 250 kv., with 50 to 60 cm. target-skin distance and filtration of 0.05 to 1.0 mm. copper, is recommended. Among 78 "determinate" cases, there were only 7 five-year survivals without evidence of disease. No cures were obtained in cases with intracranial extension.

Eleven figures; 5 charts. JOHN F. WEIGEN, M. D.
University of Pennsylvania

Contrasting Methods in the Management of Uterine Malignancy. Lewis C. Scheffey. Pennsylvania M. J. **52:** 944–951, June 1949.

This paper is a résumé of the author's experience in the diagnosis of carcinoma of the cervix and uterus, and

an account of the changing technics in treatment over a period of years.

Carcinoma of the cervix may at first be symptomless, and generally abnormal bleeding or spotting, induced by local trauma, is the only sign of the disease. One third of the author's cases were in women forty years of age or younger.

The first microscopic evidence of cancer is in the transitional zone, at the squamo-columnar junction of the external os. Invasion becomes evident only when the atypical growth has broken through the basement membrane. Non-invasive carcinoma (carcinoma *in situ*) may be present and may lie dormant for a long period of time. It has never been proved whether or not a lesion such as this can regress. In the invasive type of cancer, parametrial induration may represent inflammatory reaction rather than invasion. The various factors involved in regional and remote metastasis are difficult to evaluate. Regardless of the various theories as to the cause of the cervical cancer, a lacerated, eroded cervix is a menace, whereas a normal appearing cervix seldom becomes malignant.

Carcinoma of the body of the uterus is much less frequent—in about the ratio of 2 to 8. It is rare before the age of forty. One third of the victims never have been pregnant, and most are beyond the menopause.

The abnormal cervix should be treated whether symptoms are present or not; a circular incision followed by endothermic resection should be done in every case of eversion and papillary erosion. The Papanicolaou test is of value as a screening procedure only, and a negative report should not be relied upon without repetition.

Careful and systematic curettage is the only way to diagnose cancer of the endometrium. It is hazardous to attribute abnormal bleeding to the presence of fibroids, and if radiation therapy is instituted on the basis of fibroids alone, before ruling out cancer, irreparable harm may be done.

Seventy years ago the first abdominal hysterectomy for cancer of the uterus was done. It was the only method of treatment until radium was introduced in 1903. Until recently, irradiation was considered the method of choice in the treatment of carcinoma of the cervix, and irradiation and operation in carcinoma of the uterus. In the past five years, however, Meigs and others have turned back to radical resection. The results of this method combined with the use of the newer antibiotics will not be known until five- and ten-year cases can be evaluated.

The uterine cancer clinic was established at Jefferson Medical College in 1921 and, as of September 1948, 422 patients with cervical cancer were eligible for five-year survival studies. On the basis of the League of Nations classification, the following results are reported: Group 1, 70 per cent relative five-year survival rate; Group 2, 49 per cent; Group 3, 24.8 per cent; Group 4, 6.8 per cent; Group 5, 11.1 per cent. The histologic picture has but little influence upon the outcome, as some patients offer a more fertile field to carcinogenic growths than others. The method of treatment for carcinoma of the cervix has changed considerably over a period of years. At the present time, well filtered radium is used together with external irradiation of 5 ports, giving 1,600 to 2,400 r to each port.

One hundred and thirty-eight patients with fundal carcinoma were available for five-year evaluation: The results in this group are given according to the method of treatment. The survival percentages were: for 15 treated by adequate surgery without other treatment, 60 per cent: for 34 treated surgically and with radium and/or x-rays, but without a planned procedure, 47 per cent; for 29 treated solely by radium, 51.7 per cent; for 2 treated solely by x-rays, none; for 35 receiving combined radium and roentgen therapy, 45.7 per cent; for 23 given preoperative radium irradiation and adequate surgery, 91.2 per cent. In the last group, one patient died of recurrence and one committed suicide eight years after operation; 19 are well after five to sixteen years.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

Current Trends in Diagnosis and Treatment of Cervical Cancer. George L. Hoffman, Jr. Am. J. M. Sc. **217:** 681–689, June 1949.

The recent literature on the diagnosis and treatment of cervical carcinoma is reviewed. The author concludes: "It may be said that irradiation therapy remains the treatment of choice for most patients with cervical cancer; that results of irradiation may be favorably influenced by the addition of regional lymphadenectomy; that radical surgery can be done safely and has an increasingly important place in treatment of early cancers, particularly of the non-invasive type, and possibly in selected groups of invasive cancer; and that individualizing therapy is the best method of curing the greatest number of patients and, at the same time, assuring their comfort and happiness."

Retroperitoneal Lymph Node Dissection in Cancer of the Cervix. Joe Vincent Meigs, Langdon Parsons, and Ira T. Nathanson. Am. J. Gynec. & Obst. **57:** 1087–1094, June 1949.

The authors present a surgical approach to the problem of regional metastases in the iliac, hypogastric, and obturator areas, from carcinoma of the cervix. This procedure is undertaken only after the established form of x-ray and radium therapy has been employed for the primary disease.

In selection of a suitable case for this procedure, consideration is given to the chance of local cure three or more months after completion of the full course of radiation therapy. The actual preliminary radiation therapy has varied widely in the cases studied. However, an over-all finding of 28 per cent positive nodes following complete irradiation is recorded.

The surgical technic is described. The ease of dissection of the fatty areolar tissue from the vessels varies with the extent of radiation reaction in the tissues. The reaction appears to bear little relation to size of the dose, the voltage employed, or the duration of x-ray therapy. The operative mortality in the series of 50 cases reported was 4 per cent, two deaths being due to pulmonary embolism. Four subsequent deaths brought the total to 6.

The authors consider the immediate results encouraging, but their series is too small and too recent to permit definite conclusions.

Five tables.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

Sarcoma of the Uterus: A Report of Nine Cases. Stanley B. Reich. Am. J. Roentgenol. **61:** 830–838, June 1949.

Sarcoma of the uterus is of rare occurrence, representing 0.5 per cent to 5.0 per cent of all malignant lesions

of the uterus. Many fibroids of the uterus are cellular and may show sarcomatous degeneration; the incidence has been variously reported as 0.4 to 10 per cent. The treatment of choice is early and complete surgery. The author feels that preoperative irradiation should be given when the diagnosis has been made prior to surgery. This should be in the form of radium. Surgery should follow in six to eight weeks. All cases should have postoperative external roentgen irradiation.

The authors report 9 proved cases of sarcoma, representing 0.56 per cent of 1,627 cases of malignant lesions of the cervix and corpus. Two of the group apparently had complete removal of the tumor, followed by irradiation, with survivals of thirteen and three and one-half years, respectively. One patient with incomplete removal and intensive irradiation was followed without recurrence for over four years. Three of 6 advanced cases treated by irradiation alone showed a marked palliative effect. One patient did not respond and 2 were not followed.

Two roentgenograms; 4 photomicrographs.

J. G. LORMAN, M.D.
Indiana University

Discussion on the Artificial Menopause, Indications, Technique and Complications. Mary D. Gilmour, Margaret C. Tod, A. H. Charles, L. Martindale, and H. C. McLaren. Proc. Roy. Soc. Med. **42:** 311–320, May 1949.

This is a panel discussion by radiologists and gynecologists on the artificial menopause.

Miss Gilmour considers that radium, as a means of inducing an artificial menopause, has its chief use in the treatment of excessive functional bleeding from the uterus, more particularly when the hemorrhage occurs about the menopausal age. The actual mechanism which determines the bleeding is still obscure, but it appears that menstruation depends not only on hormonal stimuli but also upon the ability of the uterus, through its vascular apparatus, to react to these stimuli. In the radium menopause, it is reasonable to suppose that the radium produces its effect primarily through action on the vasomotor apparatus of the endometrium and not upon the ovary. A dose of 50 mg. of radium introduced into the uterine cavity for twenty-two hours is employed. Bleeding usually ceases within a few months. Infrequently further treatment may be required. The author discusses the problem of cancer as a complication of the radium menopause. In 7 of 2,050 patients cancer of the body of the uterus is known to have developed following treatment for simple hemorrhage.

Miss Tod states that the decision for producing an artificial menopause rests with the gynecologist, while the method of application and dosage are prescribed by the radiotherapist. Only in exceptional cases is it permissible to produce the menopause by x-rays without a preliminary examination to exclude malignant disease. The author reviews 940 cases treated at the Holt Radium Institute by x-rays for the production of menopause. Over 90 per cent of the patients were treated for menopausal menorrhagia and metropathia hemorrhagica. The only failures in 748 patients above the age of forty were 2 cases of fibroids and a number in which stilbestrol was given. In 100 patients under the age of forty, there were 16 failures.

Treatment consisted of either 600 r to the ovaries given over two consecutive days or 450 r in a single exposure. The author discusses her reasons for preferring the use of x-rays to radium for the production of menopause.

Charles, a gynecologist, reported 9 failures among 154 traced cases of radium-induced menopause. The immediate morbidity in 79 recent cases was 4, while of 126 patients treated by hysterectomy, 11 had a morbid postoperative course. The author discusses the advantages and disadvantages of radium *vs.* surgically induced menopause, and reaches the following conclusions: (1) Radiation therapy is a valuable measure in the treatment of uterine hemorrhage at the menopause in women without any gross pathological condition. (2) When prolapse is present as well, vaginal hysterectomy and repair is the treatment. (3) When the menopause is delayed, hysterectomy is a wiser course than radiation therapy. (4) Postmenopausal uterine bleeding, even if the curettings do not reveal a carcinoma, should generally be treated surgically. (5) Fibroids and endometriosis, in common with other female disorders, are primarily problems for the gynecologist.

Miss Martindale reports her experience with 990 cases, of which 502 were treated surgically, and 488 were given irradiation. Excellent results were obtained with x-ray therapy. The only advantage of radium treatment was in those cases in which the hemorrhage was so excessive that it was imperative to obtain its immediate cessation. There is a small but significant risk of mortality in surgical treatment.

McLaren discusses the serious menopausal symptoms which are exhibited in 47 per cent of patients following induction of the menopause with radium. Observation of 46 patients two years following radium menopause showed that sweating and flushing were still present in 31 cases. While radium is preferable to hysterectomy for uterine bleeding, the artificial menopause has serious disadvantages which require careful and prolonged follow-up.

DONALD S. CHILDS, JR., M. D.
The Mayo Foundation

Sarcoidosis. Report of Six Cases. Irwin L. Norman and William Shoemaker. U. S. Nav. M. Bull. **49:** 407–422, May-June 1949.

Six cases of histologically proved sarcoidosis occurring in a naval hospital are reported. The involvement of the lymph nodes in all of these cases tends to bear out the contention that lymphadenopathy is the most constant finding in sarcoidosis. Two patients showed involvement of the skin, and 5 pulmonary involvement. In none of the cases was there osseous involvement demonstrable roentgenographically. Roentgen therapy was given to the chest in 4 cases and to the skin in 1, with no appreciable effect.

Four roentgenograms; 5 photomicrographs.

Concentrated Roentgen Therapy of Cervical Tuberculous Lymphadenitis. Isadore Lampe, Clarence P. Chrest, and Donald A. Koch. Am. J. M. Sc. **217:** 632–636, June 1949.

The introduction of streptomycin as treatment for tuberculous involvement in various parts of the body raises the question as to the present status of roentgen therapy of tuberculous adenopathy. The purpose of the authors in the present report is: (1) to emphasize the high quality of results secured by roentgen therapy,

(2) to point out the advantages in time and convenience of their particular plan of treatment, and (3) to contrast the results of roentgen therapy with streptomycin in tuberculous adenopathy.

The authors employ a radiation technic concentrated in respect to time as opposed to the traditional protracted method. This is motivated by the practical inconvenience of the protracted method and the undesirable incidence of definite radiation damage of the skin. The factors employed are 200 kv., 0.5 mm. copper and 1.0 mm. aluminum filtration (half-value layer 0.9 mm. copper), target-skin distance 50 cm. The rate was about 50 r per minute. Fields are large enough to include the obviously diseased nodes as well as the regional group and have varied from 8 × 10 cm. up to 15 × 15 cm. Treatment is given daily, 200 r (measured in air) to one field, for four or five days. In the case of children or debilitated adults, 100 to 150 r to one field is given. The usual total dosage is 800 to 1,000 r per field and at completion the patient is asked to return in two to three months. An occasional patient is given a second course at that time. If good regression does not follow the second course, the response is considered unsatisfactory, and further radiation is not given. The reactions ensuing from this method of irradiation are insignificant.

Results were classified as satisfactory or unsatisfactory. Intermediate grades of improvement less than complete regression are all called unsatisfactory. The authors' series consists of 37 cases of cervical tuberculous lymphadenitis in which they obtained complete regression in 31 cases (84 per cent of the patients studied). Six patients were thought to show an unsatisfactory response. Of the 31 patients showing complete regression, 23 had draining sinuses present at the inception of therapy, some of these sinuses having developed following biopsy or drainage of fluctuant masses. From this it would appear that the presence of draining sinuses has no particular adverse effect on the results of radiation therapy. Conservative surgical procedures are advantageously combined with irradiation. A review of the recent literature reveals a favorable comparison of the results secured by the authors' plan of treatment with the best results obtained elsewhere.

To meet the third purpose of this study the authors have relied chiefly on the recent reports of the Council on Pharmacy and Chemistry of the American Medical Association. The Sub-Committee on Streptomycin assembled the observations on the use of this drug from widely scattered medical centers and their conclusions probably reflect the most authoritative and recent thinking on the use of specific therapy in tuberculosis and its complications. They found that the effects of streptomycin therapy on tuberculous sinuses have been sufficiently uniform to establish its usefulness. The underlying lesions in these cases were in bone, cartilage, or lymph nodes. "A number of these patients," they state "have also had one or more groups of firm, noncaseating lymph nodes. The effect of streptomycin on these nodes has been variable. In some instances a definite and prompt reduction in size occurred, while in others there has been little or no change. There is no obvious reason for the disparity of these results."

In view of the toxicity of streptomycin, careful laboratory supervision and hospitalization are recommended during the course of treatment, which extends from 90 to 120 days. Anything less than a complete course is unjustifiable. The advantage of radiation therapy is obvious, even if from this point of view alone. Results of treatment with radiation lend additional support to the belief that streptomycin therapy might best be reserved for the 15 to 20 per cent of cases which are resistant to adequate roentgen therapy.

HUGH A. O'NEILL, M.D.
Cleveland, Ohio

Roentgen Therapy for Hyperhidrosis. Observations of One Hundred and Twenty-Two Patients. J. Borak, J. J. Eller, and W. D. Eller. Arch. Dermat. & Syph. **59:** 644–652, June 1949.

Highly satisfactory results with roentgen therapy are reported by the authors in 122 patients suffering from continuous excessive perspiration of the palms, feet, or axillae. From two to eighteen years have elapsed since the termination of treatment, and in no instance has any roentgen injury of the skin been observed. Even blond patients (62 per cent of the series) seemed to tolerate the irradiation well.

The total dose required to produce an atrophy of the sweat glands is considered to be about 40 per cent of that necessary to cure a small basal-cell cancer. When filtered rays are used, such a dose can be applied without any visible reaction of the skin. The authors believe the use of unfiltered rays is the most important cause of failures in roentgen therapy of hyperhidrosis.

The following standard formula was adopted: Through a filter of at least 2 mm. (preferably 4 mm.) of aluminum, a dose of 300 r in air is given, and half of this dose is added twice at intervals of ten days. This series of treatments is repeated, if necessary, in the same manner, after an interval of four weeks. Thus, a total dose of 1,200 r in air (about 1,600 r on the skin) is administered in six sessions within a period of about six weeks. The distance between the focus and the skin is 35 cm. for treatment of the axillae, 35 to 40 cm. for the palms, and 40 to 45 cm. for the soles, the exact distance depending on the size of the field. The treatments can be given with 100 kv. machines, but the time of irradiation is considerably shortened with higher kilovoltages such as 140 kv., when a filter of 4 mm. aluminum is used.

All patients showed pronounced improvement, as a rule within three weeks after the first series of treatments. For a large number of patients a second series was unnecessary.

In order to avoid excessive dryness of irradiated areas, treatment should be discontinued after a 75 per cent improvement. No more than two series of treatments should be given.

Three photomicrographs.

X-Ray Therapy of Inflammatory Lesions of the Eyelids. Edward C. Albers and H. M. Buley. Illinois M. J. **95:** 355–359, June 1949.

In the authors' experience, the response of palpebral infections to roentgen therapy was far different from that to other types of treatment. In acute hordeolum (sty) when roentgen therapy was given early, before destruction of tissue had taken place, a rapid involution without abscess formation often resulted. Many of the infections showed involution after the first treatment, and in other cases a second treatment twenty-four to forty-eight hours later produced the desired result. In more advanced cases, abscess formation was hastened by x-ray therapy. Specifically the results were as follows:

	Cases	Cures Without Suppuration or Surgery
Acute hordoleum internum without suppuration	89	75 (85%)
Hordoleum internum with suppuration or questionable suppuration	24	14 (59%)
Hordoleum externum without apparent suppuration	10	6 (60%)
Cellulitis of eyelid	14	7 (50%)

Cures were also obtained in 12 of 20 cases of chronic meibomianitis after other methods had failed.

The authors insert a lead cup over the globe and irradiate the lids, using 55 kv. and a target-skin distance of 20 cm., with filter, at a rate of 80 r per minute. To acute cases 40 to 80 r (10 to 20 per cent of an erythema dose) were given per treatment. In chronic cases 100 to 130 r was given. The various theories for the beneficial effects of roentgen rays on inflammatory conditions are discussed.

Two tables. DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Scleroma. Review of Literature and First Report of Multiple Familial Occurrence in the United States. Paul R. Kline and Edwin R. Brody. Arch. Dermat. & Syph. **59:** 606–619, June 1949.

Scleroma, a specific chronic granuloma localized in the rhinopharyngeal tract, was apparently first limited to areas in Central and Southeastern Europe, but with the population changes attendant upon war the incidence of the disease has become nearly worldwide. To date 102 cases have been reported in the United States, 13 in native-born Americans.

A case of scleroma in a woman born in Pennsylvania is reported. She was first seen in November 1941, complaining of swelling about the upper lip and nose of eight years duration, accompanied by a persistent coryza and tenderness in the nose. Histologic examination of a nodule on the upper lip revealed the presence of scleroma. A total roentgen dose of 1,750 r, with 3 mm. aluminum filtration, was given to the sides of the nose and the upper lip. In addition, 70 mg. hr. of gamma radiation with 0.5 mm. platinum-equivalent filtration was administered to each nostril on three separate occasions. The condition improved rapidly. In 1943, after radiation therapy, the patient received three injections of antimony potassium tartrate intravenously and subsequently twelve injections of potassium iodide intravenously at weekly intervals. Complete healing resulted, and at the time of the report there was no evidence of recurrence.

The patient gave a history of having had 2 brothers with scleroma. Although a blastomycetic infection was the cause of death of one of the brothers, the evidence submitted suggests that this infection was a secondary one.

Three illustrations; 2 tables.

Subacute (Pseudotuberculous, Giant Cell) Thyroiditis and Its Treatment. John D. Osmond, Jr., and U. V. Portmann. Am. J. Roentgenol. **61:** 826–829, June 1949.

Subacute thyroiditis is a self-limiting condition of unknown etiology, probably viral in nature. The pathologic features consist of connective tissue and intralobar fibrosis with cellular infiltration made up of lymphocytes, polymorphonuclears, plasma cells, foreign-body giant cells, and histiocytes. The follicles are reduced both quantitatively and in size and contain only a small amount of colloid or none at all. Caseous foci are absent. Clinically, symptoms are ushered in rapidly, sometimes following a mild upper respiratory infection. Patients complain of pain in the neck or throat, with radiation to one or both ears. Other features consist of lassitude, easy fatigability, nervousness, weight loss, anorexia, and dysphagia. In the early stages of the disease especially, the entire gland becomes enlarged, firm, tender, but movable. Females are predominantly affected, and spontaneous recovery is usual in two or more months. No regional nodes are involved. There is low-grade fever.

The authors treated 55 cases with roentgen rays, beginning in 1933, and report 40 cures following a single course. Six cases were improved by the first course and showed a cure following the second course. A course of roentgen therapy consisted of four to six treatments of 100–150 r skin dose administered every other day, with the following factors: 200 kv., 50 cm. distance, filter equivalent to 1.0 mm. Cu. The port size was 10 × 10 cm., or large enough to cover the whole gland. No harmful effects such as myxedema or skin reaction were noted. Most patients experienced relief of pain and tenderness after two or three treatments. Constitutional symptoms were ameliorated, and the course of the disease shortened in all cases.

Three tables. W. C. GALLO, M.D.
Indiana University

A Note on Back Scatter and Depth Doses for Elongated Rectangular X-Ray Fields. D. E. A. Jones. Brit. J. Radiol. **22:** 342–345, June 1949.

As long as the ratio of length to width of a rectangular field does not exceed 1:2, depth and surface doses of roentgen rays as for square or circular fields of the same area may be used. When the ratio exceeds this, corrections should be made.

Two sets of curves, calculated by the Meredith and Neary method, are presented which provide a ready means of correcting for elongated fields covering areas up to 400 sq. cm. and proportions up to 1:10, for half-value layers of 1.0 to 5.0 mm. Cu. The calculated curves have been spot checked and found to be correct within the limits of experimental error.

Two charts; 2 tables. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Present Position of Radiotherapy in Medical Practice. B. W. Windeyer. J. A. M. A. **140:** 665–669, June 25, 1949.

The development of the position of radiotherapy in medical practice in England more accurately defines the scope of this paper. Prior to 1929 roentgen therapy was done by the diagnostic radiologists while radium therapy was done mainly by surgeons and gynecologists. In that year the National Radium Commission was established by statute and proceeded to set up various regional centers for radium therapy. As this specialty developed it was soon realized that roentgen therapy should logically be handled by these radium officers and it has gradually been separated from the diagnostic branch.

The plan of organization in England involves a small number of large centers with large supplies of radium and roentgen therapy units. The staff is a full time one and most centers are part of teaching institutions. Some therapy is done by dermatology departments but there is close collaboration with the radiologists. The staff includes a physicist, whose important contributions need no further mention.

Progress in development of equipment has been limited to accessories for beam direction and measurement. Radium needles with a greater concentration at one end have been devised to facilitate some difficult types of interstitial implantation.

Radiotherapy in some form is used (in Britain) in 60 per cent or more of patients with malignant disease. One-half of the time spent on radiotherapy is devoted to palliative treatment.

As to the future, the author looks forward to continued investigation of higher voltage therapy and the further use of radioactive isotopes, particularly radioactive cobalt.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

RADIOISOTOPES

Radioactive Isotopes in the Study of Peripheral Vascular Disease. I. Derivation of a Circulatory Index. Morris T. Friedell, Fenton Schaffner, William J. Pickett, and Irvin F. Hummon, Jr. Arch. Int. Med. **83:** 608–619, June 1949.

After a discussion of methods of determining the peripheral blood supply, with a consideration of the use of radioactive isotope tracers, the authors report their studies in a series of patients, some normal and some with arteriosclerosis.

One hundred patients from the wards of the Cook County Hospital were each given an intravenous injection of 200 microcuries of P^{32}, and the "build-up" curves indicating deposition of the radioactive isotope were determined. A semilogarithmic plotting of these curves resulted in what was essentially a straight line; the reciprocal of its slope was considered the index of circulation. These indexes fell into a normal distribution pattern, and the patients with arteriosclerosis and those over fifty years of age fell into well defined groups. The diffusion of the radiophosphorus into the tissues was faster in older and in arteriosclerotic patients. Capillary dilatation is thought to be the chief cause of this phenomenon.

Observations of previous workers on capillary dilatation and stasis are discussed. The concept that stasis due to capillary dilatation, rather than vascular spasm, is responsible for the signs and symptoms of peripheral arteriosclerosis is presented.

Six illustrations; 2 tables.

Radioactive Isotopes in the Study of Peripheral Vascular Disease. II. Method of Evaluation of Various Forms of Treatment. Fenton Schaffner, Morris T. Friedell, William J. Pickett, and Irvin F. Hummon, Jr. Arch. Int. Med. **83:** 620–631, June 1949.

The derivation of an index of circulation, calculated from the rate of diffusion of intravenously injected radioactive phosphorus into the lower extremity, has been reported (see preceding abstract). The present paper deals with studies to determine the effect on this index of circulation of treatment with histidine monohydrochloride and ascorbic acid, (2) lumbar sympathetic block with procaine hydrochloride; (3) test doses of 500 mg. of tetraethylammonium chloride, and (4) lumbar sympathectomy.

Thirty-four series of determinations were made on 26 patients, who were classified into four groups according to the variations in the circulatory index after treatment: group 1, patients for whom the circulatory index was originally low and then rose toward normal; group 2, patients for whom the circulatory index was originally low and later fell; group 3, patients for whom the circulatory index was apparently originally normal and later fell; and group 4, patients for whom the circulatory index was originally above normal and then rose even higher.

The variations in the circulatory indexes were interpreted as signifying the response of the capillary bed to peripheral vasodilators. The capillaries are considered to have an independent circulation, based largely on the demand for and deficit of oxygen. The responses to treatment in the patients in the four groups were as follows: In group 1, the capillary tone was restored; in group 2, minor vasospastic elements were relieved but capillary dilatation persisted; in group 3, major vasospastic elements were relieved but capillary dilatation persisted or increased; in group 4, deterioration of peripheral circulation was almost complete and amputation was required. The prognosis in groups 1 and 2 was favorable and in groups 3 and 4 unfavorable.

The authors conclude that radioactive phosphorus is useful as a diagnostic and prognostic tool in the evaluation of peripheral vascular states, such as arteriosclerosis obliterans.

Two illustrations; 4 tables.

Study of Peripheral Vascular Disease with Radioactive Isotopes. Part II. F. W. Cooper, Daniel C. Elkin, Patrick C. Shea, and E. W. Dennis. Surg. Gynec. & Obst. **88:** 711–718, June 1949.

This is the second part of a paper dealing with the investigation of circulatory physiology of the extremities by the use of radioactive sodium 24. Part I (Surg. Gynec. & Obst. **87:** 1, 1948) was abstracted in RADIOLOGY **52:** 903, 1949. The results of one of the methods described in that paper are evaluated here.

The method consists of an injection of 10 microcuries of radioactive sodium chloride (a gamma emitter) in approximately 0.2 c.c. of sterile solution into the gastrocnemius muscle. The rate of decrease of the injected isotope, as it is mobilized into the vascular system, is determined by a Geiger-Müller tube centered over the injection site for a ten-minute period.

Fifty-seven normal subjects were investigated and the rate of disappearance of the isotope from the muscle was found to be constant and expressible as a linear function when plotted on semilogarithmic paper. In all individuals, the rate of absorption varied with the rate and volume of blood flow to the extremity. Many factors control the latter, including emotion, activity of the part, environmental temperature, and the patient's basal condition. All of these must be maintained as constant as possible.

The rate of mobilization of sodium from the muscle

proved to follow a rather constant pattern in normal subjects. One hundred and two patients with various vascular abnormalities were studied. The rate of mobilization was increased in the following conditions: (1) hyperthyroidism, (2) essential hypertension, (3) thrombophlebitis without arterial insufficiency, especially if the skin temperature was elevated. The rate of mobilization was decreased in: (1) advanced Buerger's disease with involvement of the larger arteries and (2) thrombophlebitis with edema and arterial insufficiency. The removal rate was most invariable and even more constant than normal in cases of arteriosclerosis obliterans, since there is less variability in vascular tone and blood flow.

The authors believe this is a valuable additional method of evaluating circulatory physiology of the extremities and that it offers a means of evaluating therapeutic measures used in treating peripheral vascular disease.

Eight illustrations, including 1 roentgenogram.

DOUGLAS NAGLE, M.D.
University of Pennsylvania

Chronic Lymphatic Leukemia. A Study of 100 Patients Treated with Radioactive Phosphorus. John H. Lawrence, B. V. A. Low-Beer, and James W. J. Carpender. J. A. M. A. **140:** 585–588, June 18, 1949.

Included in the series of 100 patients forming the basis of this study are all those with chronic lymphatic leukemia who were treated with radioactive phosphorus at the University of California in Berkeley and San Francisco since the work was started by one of the authors in 1936. The patients were followed until Sept. 1, 1948, only 3 being lost to follow-up. Fifty-eight patients either had roentgen therapy before receiving P^{32} or were given it afterward because of local indications such as enlarged lymph nodes or a large spleen.

The dosage was based on the calculation that 1 microcurie of P^{32} per gram of tissue will give about 40 r of irradiation in twenty-four hours. In general, P^{32} was given to produce symptomatic relief. This, when achieved, with an improved red cell count and decrease in size of the spleen and lymph nodes, was considered a good response. The attempt to bring the white cell count down to normal or to near normal, with a normal differential count, was not made because of the danger of too great a depression of the bone marrow and decreased production of normal cells. By this method the average patient received 1–2 millicuries per week for four to eight weeks. This dosage was repeated when indicated by a return of symptoms or other evidence of increased activity of the disease process. These small doses were found adequate for controlling symptoms in most patients for shorter or longer periods of time. Some of the patients received P^{32} for as long as ten years and only one received a total dose greater than 50 millicuries.

In the authors' series there was a suggestion of a favorable relationship between a high original hemoglobin and duration of life. It was also noted that with an onset between the ages of thirty and forty years, the average survival was longer than in other age groups. No correlation was observed between the height of the initial white cell count and survival time. There was noted a small increase in the average duration of life with this form of therapy as compared with series in which roentgen irradiation alone was used; however, the significance of this increase (average now approaching five years) cannot be evaluated without a greater number of cases followed for a longer period of time.

The authors are aware of the possibilities of over dosage and deleterious effects, as in the use of general body irradiation with roentgen rays or radium. A number of patients had decreases in the thrombocyte counts to rather low levels and some showed low red cell counts after therapy. As these effects may be due also to the disease process, they constitute a major problem in the determination of the amount of therapy advisable, whether it be P^{32}, total body or local irradiation. Sternal bone marrow examination may be of assistance in making the decision but one cannot be completely dependent on this, as leukopenia, anemia or thrombopenia due to irradiation may be present with a hyperplastic marrow which ordinarily constitutes an indication for therapy.

Success of therapy depends on the greater sensitivity of the leukemic cells to irradiation and often this is slight. Therapy is limited in some cases by the adverse effect on normal cells and in others by what appears to be a gradual decrease in the ratio of sensitivity between leukemic and normal cells as the period of treatment lengthens. It is often necessary to treat a patient in the face of falling red cells and thrombocyte counts in the hope that this decrease can be corrected or alleviated by inhibiting the leukemic marrow infiltration. Often palliation is all that can be achieved, but control of the disease is possible in a good percentage of patients. It appears that the ease with which this is accomplished, by providing generalized irradiation, and the lack of radiation sickness in this form of therapy makes the use of P^{32} advantageous. The failure to produce control or remarkable prolongation of life in many patients points to the need for much further research on this problem in the hope that, with a better understanding of the nature of leukemia, improved methods of therapy will result.

WILLIAM H. SMITH, M.D.
Louisville, Ky.

Uptake of Radioactive Phosphorus by Malignant Brain Tumors. Theodore C. Erickson, Frank Larson, and Edgar S. Gordon. J. Lab. & Clin. Med. **34:** 587-591, May 1949.

Inorganic phosphate containing P^{32} was administered parenterally to 10 patients with malignant intracranial tumors. Two tables are presented, one showing the quantitative uptake of P^{32} by tumor as compared with normal brain tissue and the other the fractionation of tissue phosphorus in 4 subjects studied by this technic. These data reveal that there was an increase in concentration of the phosphorus in the tumor tissue in every instance as compared with the normal brain, the ratios varying from 1.6:1 to 29:1. The highest concentration obtained after intravenous injection was 19:1. In general there appeared to be a rough correlation between the phosphorus uptake and the anticipated metabolic activity of the tissue as judged on the basis of the degree of malignancy.

Chemical fractionation of tissue phosphorus showed a small but significant concentration in the nucleoprotein of both cytoplasm and nucleus. The implications of these findings are discussed.

The Metabolism of the Radioactive Elements Created by Nuclear Fission. Joseph G. Hamilton. New England J. Med. **240:** 863–870, June 2, 1949.

This paper covers much the same material as the article on "The Metabolism of the Fission Products and the Heaviest Elements" in RADIOLOGY for September 1947 (**49:** 325, 1947).

Six illustrations; 1 table.

Human Autoradiographs Obtained with a Radioactive Isotope of Zinc. J. H. Müller. J. de radiol. et d'électrol. **30:** 290–293, 1949. (In French)

In preceding publications the author has shown the results of autoradiography performed in the rat and the mouse following intravenous injections of Zn^{65}. In the present article he submits autoroentgenograms of two patients suffering from generalized carcinomatosis secondary to carcinoma of the breast. These women were given therapeutically 100 millicuries of radioactive Zn^{65} in the chemical form of the oxide. The roentgenograms followed exposure of the film for six hours in one patient and seven hours in the other. The films show intense shadows of the liver, the kidneys, the superficial blood vessels of the skin and the nipple of the remaining breast. From the animal studies it had been determined that there is a transitory accumulation of the zinc oxide in these organs. The patients experienced no ill effects except for a mild leukopenia of short duration. It is thought that this procedure may be of practical use, especially in the study of diseases of the superficial blood vessels, which were shown quite clearly in the films obtained.

Four roentgenograms. E. M. SAVIGNAC, M.D.
Detroit, Mich.

Tumorous Growths in the Pituitary and Trachea Following Radiotoxic Dosages of I^{131}. Aubrey Gorbman. Proc. Soc. Exper. Biol. & Med. **71:** 237–240, June 1949.

Following doses of radioactive iodine sufficient to cause destruction of most or all of the thyroid, tumorous enlargements were found in the pituitary glands and tracheas of mice. Hypophyseal growths as large as 240 mg. (control, 2.1 mg.) occurred. Less than 10 per cent of animals sacrificed more than 250 days after I^{131} administration had pituitaries weighing less than 10 mg.

Tracheal tumors of the fibrous tunica propria, obstructing the tracheal lumen, were of lower incidence (4 per cent) but appeared earlier. Fibrous thickenings of the tunica propria and metaplastic regeneration of tracheal epithelium were more common.

This study is based on 158 mice observed for a period of time sufficient to show the metaplastic and atypical growth changes, as well as 34 untreated controls.

One chart.

EFFECTS OF RADIATION

The Radiation Syndrome. Elizabeth E. Painter and Austin M. Brues. New England J. Med. **240:** 871–876, June 2, 1949.

This is an extensive review of the effects of radiation on various animals and man as reported in the literature and the theories that have been presented in explanation of these. The syndrome is divided into three phases: (1) the initial shock phase of radiation sickness, appearing shortly after treatment, with prostration, diarrhea, urination, lacrimation, and anorexia, and sometimes nausea and vomiting; (2) the acute phase beginning about one week after irradiation, showing a systemic deterioration, with a decrease in the total blood count, especially in the lymphocyte group, later followed by a decline in the granulocytes; (3) a chronic phase which is characterized by shortening of life and tumor production.

So many changes are described in such a variety of animals and under such varied conditions that the entire article must be consulted for adequate appreciation.

One table. JOHN B. MCANENY, M.D.
Johnstown, Penna.

Case of Sarcoma in Irradiated Mandible. Sigvard Kaae and Mogens Glahn. Acta radiol. **31:** 431–434, June 30, 1949.

The authors report a case of fibrosarcoma of the mandible in a 62-year-old male who had been treated for a carcinoma of the gingival margin thirteen years previously. The treatment had consisted of electrocoagulation and radium application.

It is noted that Woodard and Coley found that doses of 3,000 r caused permanent damage to the regenerative capacity of normal bone and that doses of more than 5,000 r were likely to cause complete devitalization of adult bone. The cases previously reported in the literature as sequelae to irradiation were various types of osteogenic sarcoma, in some cases with a preponderance of cartilaginous elements.

The authors cannot believe that the mere possibility of causing bone sarcoma years later should alter the indications for irradiation therapy of malignant disease in the neighborhood of bones.

One roentgenogram; 3 photomicrographs.

ALBERT BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Ionizing Radiation Injury. Its Diagnosis by Physical Examination and Clinical Laboratory Procedures. Eugene P. Cronkite. J. A. M. A. **139:** 366–369, Feb. 5, 1949.

The development of cyclotrons and the atomic energy industry has greatly increased the occupational hazard from exposure to ionizing radiation. The injuries produced are qualitatively the same as those due to other sources of radiation but the rising number of persons exposed and the new sources of exposure increase the problem quantitatively. Intentionally excluding the aspects of prevention, the author discusses the diagnosis of radiation injury by means of physical examination and laboratory procedures.

The first part of the report deals with the effects of a single intense exposure, defined arbitrarily as a total body exposure of more than 25 r delivered within a few hours. There is a latent period between exposure and onset of symptoms which is inversely proportional to the amount of radiation. The shorter the latent period the more severe the symptoms, and the rate at which

the disease progresses is a direct function of the dose of radiation received. Death may occur during irradiation or within twenty-four hours when the exposure exceeds 10,000 r.

The early hematologic responses in man are unknown, but the author tentatively states that, if there is no lymphocytopenia in twenty-four to forty-eight hours, the total body exposure has been less than 25 r and symptoms probably will not occur. Between 25 and 100 r a fleeting lymphocytopenia will appear and symptoms will probably be mild. Following exposures of 100 to 200 r the lymphocytopenia will be more prolonged and marked, symptoms will be more severe, and death may occur. Above 200 r symptoms will increase greatly in severity and death will ensue more frequently.

Symptoms other than the hematologic response are nausea, vomiting, diarrhea, purpura, epilation, and agranulocytic infections. The cutaneous changes resemble those following thermal burns.

The second portion of the article covers the aspects of injury from repeated small exposures, the bulk of the section being devoted to hematologic response as a biologic index to chronic over-exposure. Stressing the wide variation in "normal" blood counts and lack of dependability of "average" counts, the author advocates making base-line counts individually on persons before exposure occurs, with subsequent counts at monthly intervals. The following alterations from the base-line counts are presumptive evidence of excessive exposure: (*a*) persistent leukopenia below 4,000; (*b*) persistent leukocytosis above 15,000 with absolute lymphocytosis; (*c*) relative lymphocytosis with low total count (4,000–6,000) returning to base-line following removal from exposure; (*d*) increased mean corpuscular volume, shift of Price-Jones curve to the right, increased mean corpuscular diameter; (*e*) reticulocyte count over 2 per cent; (*f*) erythrocytosis—red blood cells over 5,800,000, hemoglobin over 18.0 gm.

Suggested aids in determining the cause of abnormal blood findings are: (1) removal of the suspect from all sources of exposure; (2) differential counts of radiation on excreta, nasal swabs, and expired air to establish type and degree of internal exposure to radioactive isotopes; (3) weekly blood studies compared with base-line count (4) elimination of other factors such as virus diseases, infectious mononucleosis, etc., as causes for blood changes.

One graph; 2 tables.

D. J. SAYLES, M.D.
University of Michigan

Physicians in an Atomic War. Leon O. Jacobson, R. S. Stone, and J. Garrott Allen. J. A. M. A. **139:** 138–140, Jan. 15, 1949

With the explosion of the first atomic bomb, a new source of wartime medical casualty was born. The authors state that it is essential that physicians become familiar with the biological effects of radiations and with the methods of treatment of radiation injury.

From experiences at Hiroshima and Nagasaki, broad principles have been formulated. It is assumed that induced radioactivity or contamination with radioactivity in the vicinity of an atomic bomb explosion is negligible, and teams of medical workers can immediately enter the area. Approximately one third of the population of a bombed city will be killed outright or die within a few weeks of the explosion no matter how soon medical care is made available. Another third will survive if adequate care is provided quickly, and, barring other hazards, the remaining third have a fair chance of surviving without medical aid.

Some have suggested the following ways of emergency organization and mobilization: (1) construction of facilities at the outskirts of cities for hospitalization, examination of ambulatory patients, distribution of emergency rations; (2) planning for well trained and strategically placed workers to police and evacuate casualties; (3) provision for on-the-scene determination of the radius from the center of which evacuation is useless, the area in which evacuation is worth while, and the periphery in which little medical attention is necessary.

The human response to total body irradiation is not exactly known but is roughly as follows: 50–200 r would produce nausea, transitory leukopenia, and thrombopenia with complete recovery; 200–400 r would produce severe leukopenia, thrombopenia, mild anemia, severe gastro-intestinal disorders, moderate hemorrhages, and death in a small percentage of cases; 400–600 r would accentuate and prolong the above symptoms and less than 50 per cent would survive. Above 600 r relatively few persons would survive, even with the best medical care.

The skin should be treated as one treats thermal burns, inasmuch as radiation burns may not appear for a week or more. Liberal plasma and blood transfusion is advocated. Antibiotics are essential to combat the infections coincident with severe leukopenia, and parenteral nourishment may be necessary if gastro-intestinal symptoms are severe.

The authors discuss recent research on radiation injury and conclude that the physician must play a role in the investigation of these problems during peace as well as handling casualties in the event of an atomic war.

D. J. SAYLES, M.D.
University of Michigan

Dosage-Mortality in Rats Given Total Body Roentgen Irradiation. William G. Clark and Rex P. Uncapher. Proc. Soc. Exper. Biol. & Med. **71:** 214–216, June 1949.

The LD 50 for total body roentgen irradiation in Wistar rats was found to be 640 ± 5 r with a thirty-day end point. The time elapsing before 50 per cent mortality occurs at different doses is a more reliable measure of mortality than the dosage-mortality curve or the dosage survival tissue curves for different x-ray doses. The dosage-mortality curve of rats has such a steep slope in the LD 50 range that variations in mortality of from 0 to nearly 100 per cent may occur in this range because of variations in animals and the x-ray machine output. Therefore, in studies directed toward therapy or protection, if the mortality curves are extremely steep as in the rat, dosages in the LD 50 range should not be used. Other measures which might be employed are discussed.

Over 500 animals were used in the study.

Three graphs; 2 tables.